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Laboratory Evaluation of a Colorimetric Hydrazine Dosimeter

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<p>A passive, colorimetric dosimeter badge was manufactured for NASA by GMD Systems. The badge consisted of two indicators: para-dimethylaminobenzaldehyde (PDAB) and vanillin. When exposed to hydrazine or monomethylhydrazine (MMH), the PDAB turns orange and the vanillin turns yellow. The intensity of the color is proportional to the concentration in the environment. A color wheel was also manufactured to evaluate the color and estimate the dose of hydrazine for each indicator. The laboratory investigations and the preliminary results of the field test indicate that the badge is qualitatively accurate with few interferences. The badges were exposed for sample times between 0.25 and 16 hours at different concentrations of hydrazine and MMH. The badges were evaluated for linearity, relative humidity effects, and interferences. The evaluation was conducted at the Naval Research Laboratory and Wiltech at the Kennedy Space Center. The badges responded with a measurable color change in each test. At low dose and short sample times, there was much scatter in the dose measured. The badges saturated, exceeding the darkest color on the color wheel after 8 TLV-hours. Relative humidity has little effect on the badge responses. Sunlight was an interferent for PDAB, turning it yellow. Tobacco smoke was an interferent for vanillin, turning it pink-purple.</p>			
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Hydrazine Laboratory Evaluation Test and Evaluation INDICATORS

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LABORATORY EVALUATION OF A COLORIMETRIC HYDRAZINE DOSIMETER

INTRODUCTION

The three hydrazines currently being used by the Department of Defense as hypergolic fuels are hydrazine, monomethylhydrazine (MMH), and unsymmetrical dimethylhydrazine (UDMH). The space shuttle program uses large quantities of hydrazine and MMH. In addition, substantial amounts of hydrazine are used by Titan missiles, satellites, and aircraft auxiliary-power units. While useful as propellents, the hydrazines impose health hazards to personnel who may come in contact with them. Hydrazine, MMH, and UDMH are considered potential carcinogens and threshold limit values (TLV) for exposure to their vapors have been established at 100, 200, and 500 ppb respectively by the American Conference of Governmental Industrial Hygienist (ACGIH) [1]. At higher concentrations there is added danger due to the explosive nature of the hydrazines. To minimize risk, monitoring of the employees and their work environment should be conducted to insure the presence of hydrazines remains below the defined levels. While instruments to monitor areas are commercially available, a small, reliable, real-time, passive device that can be worn by personnel is not.

Geo-Centers and Naval Research Laboratory (NRL) scientists invented a passive sampler for the determination of personnel exposure to MMH and hydrazine [2]. The sampler required laboratory evaluation. For real-time qualitative detection, a badge which incorporates vanillin as an indicator showed potential in laboratory evaluations at NRL. When exposed to a hydrazine, the coated substrate develops a yellow color. A patent for the vanillin indicator was issued in February 1990 [3].

GMD Systems, Inc. investigated several colorimetric systems for incorporation into a passive dosimeter through a Small Business Initiative Research Contract with NASA/Kennedy Space Center (KSC). One chemistry was identified by GMD Systems. This indicator, para-N,N-dimethylaminobenzaldehyde (PDAB), can also be used for real-time qualitative hydrazine detection. The PDAB coated dosimeter develops an orange-red color upon exposure to the hydrazines. NASA requested that the vanillin developed by Geo-Centers and NRL personnel be incorporated into the GMD prototype dosimeter badges. Geo-Centers and NRL personnel agreed to collaborate with GMD. An extensive laboratory test was designed to investigate the prototype badges. The color dosimeters were evaluated as dose indicators for MMH and hydrazine by NRL and by Wiltech at KSC.

The evaluation of the color badges was a joint effort between Wiltech and Boeing Aerospace Operations at the Kennedy Space Center, and NRI and Geo-Centers, Inc.

THEORY

The extreme reactivity of the hydrazines is responsible for a variety of technical problems encountered in performing ambient air monitoring. One approach that utilizes this reactivity is derivatization of the hydrazine to a species that is easier to analyze. There currently exists an ASTM analytical method that is based on the condensation of a hydrazine and an aldehyde, resulting in a product known as a hydrazone. The formation of a hydrazone is depicted in Figure 1. In the case of unsubstituted hydrazine (N_2H_4), two moles of aldehyde can react with one mole of hydrazine to form the azine. The mechanism involves the nucleophilic addition of the nitrogen base, followed by the elimination of water. This reaction is frequently acid catalyzed by protonation of the carbonyl. The ASTM method condenses the hydrazine with para-N,N-dimethylaminobenzaldehyde (PDAB), Figure 2. In an acidic solution, the absorbance of the protonated p-quinone structure is measured spectrophotometrically at 458 nm [4].



Figure 1. The condensation reaction of a carbonyl group with a hydrazine to form a hydrazone

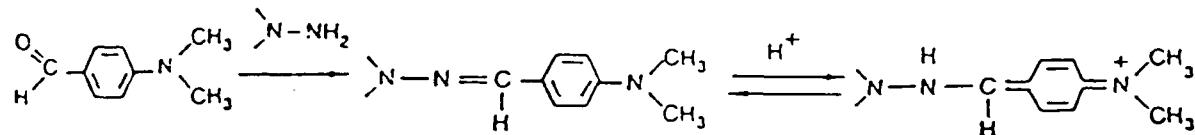


Figure 2. Condensation reaction of PDAB with a hydrazine to form the protonated p-quinone structure

Vanillin (3-methoxy-4-hydroxybenzaldehyde) is also an excellent derivatization agent for hydrazine and MMH. Figure 3 shows the reaction of hydrazine and vanillin. The formation of the hydrazone is rapid. Vanillin does not need to be acidified to react with MMH, however, it does require acidification to form a colored species upon reaction with hydrazine. Reaction with UDMH does not form a colored species. This characteristic allows a wider pH range than with other aldehydes (such as the PDAB previously mentioned) when monitoring MMH. This has proven beneficial when investigating interferences, such as ammonia, that can alter the pH.

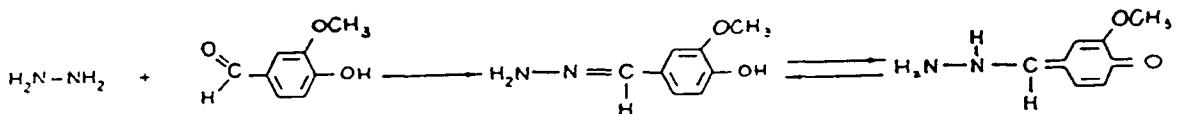


Figure 3. Condensation reaction of vanillin and hydrazine

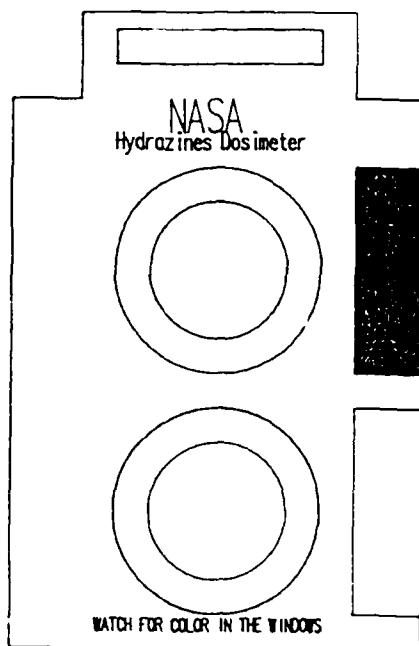
The vanillin must be acidified to form a visual product upon reaction with hydrazine. Hydrochloric acid (HCl) was tested in this capacity, however, HCl was too volatile. Therefore, the use of citric, phosphoric and sulfuric acids were investigated. Phosphoric acid was the most suitable. We believe that non-acidified vanillin reacts with hydrazine to form the hydrazone. Upon acidification, the hydrazone turns yellow. This effect was used to make a badge sensitive to acid vapors [5].

EXPERIMENTAL

BADGE SYSTEM

Approximately 350 color badge systems were evaluated at NRL and 275 by Wiltech at the Kennedy Space Center. The badge designs incorporated vanillin and PDAB and were designed as dual spot units. Each unit was given a serial number and foil wrapped by the manufacturer. As a randomization procedure, all badges were scrambled by KSC personnel prior to distribution. The dosimeters were composed of two strips of filter paper coated with either indicator. These strips were sandwiched in a thin cardboard housing 7.3 cm by 4.4 cm in size. The housing face had two 1.25 cm diameter circles cut out for exposure of the coated paper. A tabbed section at the bottom of the badge provided a means of easily removing the protective cover over the indicator spots immediately prior to use. Figure 4 shows the badge. Badges with different color chemistries were designated as D12, D14, D13+D12, and D13. Later in the testing period, composite badges of D12+D14 were produced. Table I lists the indicators coated on each badge type. All badges with the exception of the D13+D12 badges and the later composite badges had a diffusion membrane over the indicator spot at the top of the badge. The membrane had little effect on color development. After three months of testing, the diffusion membrane was removed from all badges used in subsequent exposures at NRL. The membrane was not removed from the badges tested at Wiltech.

Front View of Badge



Back View of Badge

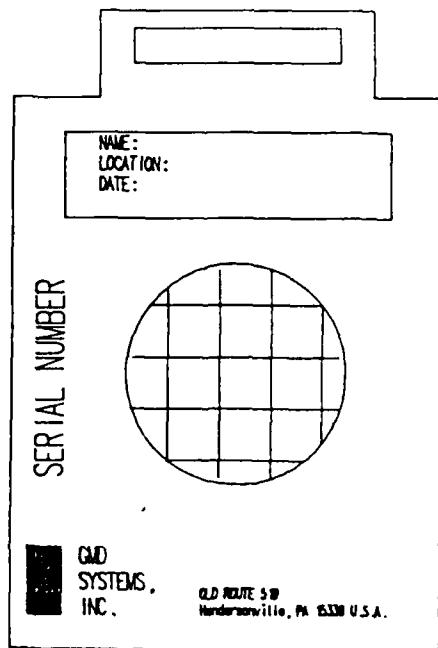


Figure 4. GMD Systems, Inc. Hydrazine Color Dosimeter

Table 1. Badge Types Evaluated

Badge Designation	Indicator	Testing Facility
D12	PDAB	NRL/Wiltech
D13	Vanillin/Citric acid	NRL
D14	Vanillin/Phosphoric acid	NRL/Wiltech
D13+D12	Vanillin/CA + PDAB	NRL/Wiltech
D12+D14	PDAB + Vanillin/Phos. Acid	NRL/Wiltech

GMD provided color wheels (badges dose indicators) with which to match the color development on the exposed dosimeters. During the course of testing, three different color wheels were used. The first consisted of nine shades of increasing intensity of yellow for vanillin (D13, D14) or red-orange for PDAB (D12). It was noted that some of the colors on the wheel were so close in shade there was difficulty in distinguishing between them. Another problem was that the low-dosage shades on the PDAB color wheel were much more pink than the badges exposed to MMH. The color mismatch made it difficult to read the badges well. New color wheels were produced with color intensities ranging from 1 to 5. The five colors on the new vanillin wheel were intended to be the same as the odd numbered colors on the original wheel. However, the number 4 color on the new wheel matched the number 8 color on the old wheel and the color of the number 5 dot on the new wheel was slightly more intense than the 9 color on the old wheel. The colors on the PDAB color wheel were altered slightly for more orange shades. This is more evident in the lower numbered color dots on the old new wheel. The intensities of the color dots on the new PDAB wheel were similar to the color intensities of the odd numbered colors on the old wheel. However, the number 4 color dot on the new wheel more closely matches 7.5 color on the old wheel. The number 5 color dot on the new PDAB wheel is slightly darker than the number 9 color on the old wheel. The new color wheel was used to evaluate the newer PDAB/vanillin (D12+D14) badges.

The shade of orange produced when PDAB reacts with hydrazine is different than that produced with MMH. Therefore, a different PDAB color wheel was designed for hydrazine exposures. The color spots on this wheel were orange.

TEST PLAN

The following tables outline the test plan for the dosimeter evaluation for MMH. Table 2a gives linearity test parameters, Table 2b, humidity parameters, and Table 2c lists interferents to be tested. Additional badges were sent to NRL for evaluation as hydrazine dosimeters under similar conditions. Each exposure was replicated. Some required doses were duplicated between NRL and Wiltech to insure no laboratory bias. The following tolerances applied to all controlled test parameters: MMH concentration (ppm), $\pm 20\%$; exposure time (hrs), $\pm 5\%$; relative humidity (%), $\pm 5\%$; and temperature (C), ± 2 .

To achieve the desired doses of MMH or hydrazine, the badges were exposed to various concentrations of the contaminant gas for different periods of time. Figure 5 shows the glass chamber in which the badges were exposed to MMH and hydrazine. The chamber was cylindrical with conical ends. The exhaust end was removable to allow insertion of the dosimeters. Teflon baffles placed at each end were used to induce laminar flow. The badges were hung vertically and back-to-back on a glass rod which was secured to the front and rear teflon baffles in the chamber. A flow of $5.0 \pm 10\%$ SLPM was specified for the evaluation. This corresponds to a velocity of 79 cm/min (2.6 ft/min).

The system used to generate MMH and hydrazine supplies concentrations from approximately 0.5 to 10 times the TLV for each compound. This system has been previously described in detail [6]. Diffusion tubes, housed in a constant temperature bath and continually purged with 100 ml/min of dry nitrogen, provide the hydrazine vapors. The desired concentration is obtained by adjusting the temperature of the bath, the size of the diffusion capillary, and/or the amount of dilution air. The concentration in the test chamber was independently verified using impinger collection and coulometric titration before and after each test. The coulometric titration procedure used to verify the concentrations of the dynamic test environment is described in detail in earlier reports [7].

The same type of glass chamber was used to expose the badges to the gaseous interferents that were tested at NRL. Badges were subjected to heat, cold, UV light and sunlight at Wiltech. Those badges exposed to heat and cold were placed in a convection oven (40°C) and freezer, respectively. To assess interference by UV light, badges were exposed to a UV lamp.

Immediately after each exposure ($T=0$), the color development on the dosimeters was judged by three people using the appropriate color wheel. Three people also judged the color on the badges one hour after exposure ($T=1$). Whenever possible, the same people who evaluated the badges at $T=0$ read them again at $T=1$. Although the colors on the color wheels were whole numbers (x), judges could choose a shade in between two colors (x.5), if necessary. The badges exposed to the interferents were evaluated both after exposure to MMH and to the interferent. The serial numbers, exposure conditions, and data obtained from each badge were recorded on log sheets (Appendices A and B).

Table 2a. Linearity Response

MMH Conc (ppm)	Exposure Time (hours)	Dose (TLV-hrs)	RH %	Facility	Priority
Control	4.0	0.0	40	WT/NRL	I
0.1	0.25	0.13	40	WT/NRL	II
0.1	0.5	0.25		WT	III
0.1	1.0	0.5	40	WT	III
0.1	2.0	1.0	40	WT/NRL	II
0.1	4.0	2.0	40	NRL	III
0.1	8.0	4.0	40	NRL	III
0.1	16.0	8.0	40	WT/NRL	II
0.2	0.25	0.25	40	WT/NRL	II
0.2	0.5	0.5	40	WT	III
0.2	1.0	1.0	40	WT	III
0.2	2.0	2.0	40	WT/NRL	II
0.2	4.0	4.0	40	NRL	III
0.2	8.0	8.0	40	NRL	III
0.2	16.0	16.0	40	WT/NRL	II
0.4	0.25	0.5	40	WT/NRL	II
0.4	0.5	1.0	40	WT	III
0.4	1.0	2.0	40	WT	III
0.4	2.0	4.0	40	WT/NRL	II
0.4	4.0	8.0	40	NRL	III
0.4	8.0	16.0	40	NRL	III
0.4	16.0	32.0	40	WT/NRL	II
1.0	0.25	1.25	40	WT/NRL	II
1.0	1.0	5.0	40	WT/NRL	II
1.0	3.0	15.0	40	WT/NRL	II
4.0	0.5	10.0	40	WT/NRL	II
6.0	0.25	7.5	40	WT/NRL	II

Table 2b. Humidity Response

MMH Conc (ppm)	Exposure Time (hours)	Dose (TLV-hrs)	RH (%)	Facility	Priority
Control	4.0	0.0	10	WT	IV
Control	4.0	0.0	80	NRL	IV
0.1	0.25	0.13	10	WT	IV
0.1	2.0	1.0	10	WT	IV
0.1	0.25	0.13	80	NRL	IV
0.1	2.0	1.0	80	NRL	IV
0.2	0.25	0.25	10	WT	IV
0.2	2.0	2.0	10	WT	IV
0.2	0.25	0.25	80	NRL	IV
0.2	2.0	2.0	80	NRL	IV
0.4	0.25	0.5	10	WT	IV
0.4	2.0	4.0	10	WT	IV
0.4	0.25	0.5	80	NRL	IV
0.4	2.0	4.0	80	NRL	IV
1.0	0.25	1.25	10	WT	V
1.0	2.0	10.0	10	WT	V
1.0	0.25	1.25	80	NRL	V
1.0	2.0	10.0	80	NRL	V

Table 2c. MMH/Interferent Interaction Response

MMH Conc (ppm)	Dose (ppm-hours)	Interferent	Int. Conc. (ppm)	Exposure Time (hrs)	Facility
0.2	2	Sunlight	NA	4.0	WT
0.2	2	UV Light*	NA	0.5	WT
0.2	2	Heat 40 C	NA	4.0	WT
0.2	2	Cold 0 C	NA	4.0	WT
0.2	1	NO2	5	1.0	NRL
0.2	1	NH3	20	1.0	NRL
0.2	1	Freons	30	1.0	NRL

* 254 and 350 nm

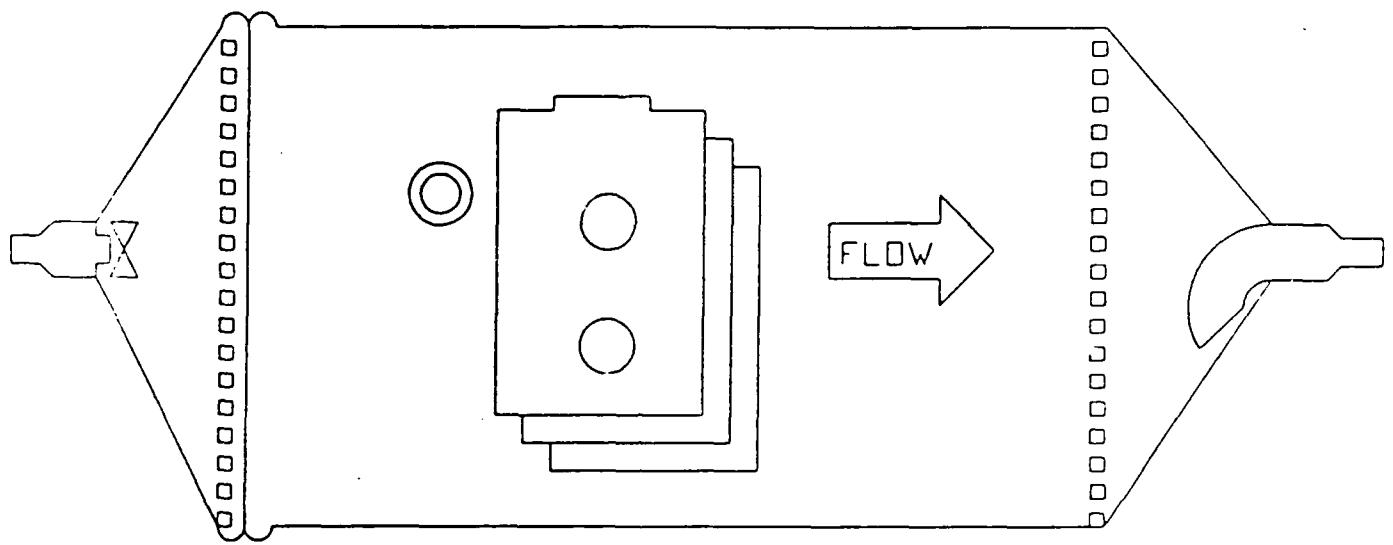


Figure 5. Dosimeter Exposure Chamber

FIELD TEST

The badges were field tested at Kennedy Space Center to investigate their performance in the field and to identify potential interferences. The badges were tested as area monitors and personal dosimeters. Individuals who wore the dosimeters were interviewed to determine their activities during the day. Eleven tests were conducted at different locations over a two month period. Three different location types were identified for testing: Expected Exposure, Unlikely Exposure, and Potential Exposure. Badges in the expected exposure area had a high probability of being exposed because hydrazine or MMH was being used or stored in that area. The unlikely exposure areas were used to test unusual interferences only, no hydrazine or MMH was ever used in those areas. The potential exposure areas included areas where hydrazines were used or stored at some time, but were clean during the test. These areas were selected to examine likely interferences. All of the tests and locations are given in Table 3.

Citric acid badges were used in conjunction with the colorimetric badges as a reference to independently monitor exposures. The performance of the citric acid badges was described in detail in an NRL Memorandum Report entitled "Field Evaluation of a Passive Sampling Device For Hydrazines in Ambient Air" [7]. Two badges were provided at each location. One badge was analyzed using coulometric titration [8]. The second badge was analyzed by a colorimetric method, phosphomolybdic acid, NIOSH approved method #S149 [9], or the badge was spiked and analyzed with the coulometric method. All of the badges were distributed and collected for analysis on a daily basis. For some tests, liquid impingers were also collected and analyzed by the ASTM para-dimethylaminobenzaldehyde colorimetric method.

RESULTS

DOSE RESPONSE RESULTS FOR MMH

All of the badges showed a large range in color development at doses less than 2.5 TLV-hours regardless of MMH concentration. At low sample times, some of the scatter is due to the experimental procedure. When the chamber is opened to insert the badges, the MMH atmosphere is disturbed. Thus, when the dosimeters are exposed to the gas for a short time, the atmosphere in the chamber may not stabilize during the time the badges are present.

Figures 6a and 6b are dose response graphs of PDAB (D12) badges without the diffusion membrane at T=0 and T=1, respectively. These badges show an increase in color development from T=0 to T=1. Although the time dependence is independent of dosage, the outlying data points at ≤ 5 TLV-hours show the greatest increase in color from T=0 to T=1. Because of this, the scatter in the outlying data points evident at T=0 is diminished by T=1 as the colors become more intense and approach saturation color. At 10 TLV-hours, the badges reached a saturation color of 9.5. Figures 6c and 6d are dose response graphs of the top color dot on PDAB (D12) badges that had the membrane. The outlying data points at < 5 TLV-hours noted on the badges without the membrane are not present here. Color saturation occurs by 16 TLV-hours at T=0. Due to the increase in color

Table 3. Field Tests Conducted at Kennedy Space Center.

Locations	Area	Chemical Agent
Expected Exposure:		
Wiltech Lab	I Personnel	Hydrazine MMH
Orbiter Processing Facility (OPF)	I II	MMH MMH
Aft Skirt Testing Facility (ASTF)	I II Personnel	Hydrazine Hydrazine Hydrazine
Unlikely Exposure:		
M & O Paint Shop	Personnel	Solvents
VAB Break room (Lounge)	I	Cigarette Smoke
Astronaut Beach House	I	Sea Breeze
Potential Exposure:		
Rotating Service Structure (RSS)	I II	Hydrazine MMH
Hypergol Maintenance Facility (HMF)	Personnel	MMH
Fuel Storage Area (FSA)	Personnel	Hydrazine

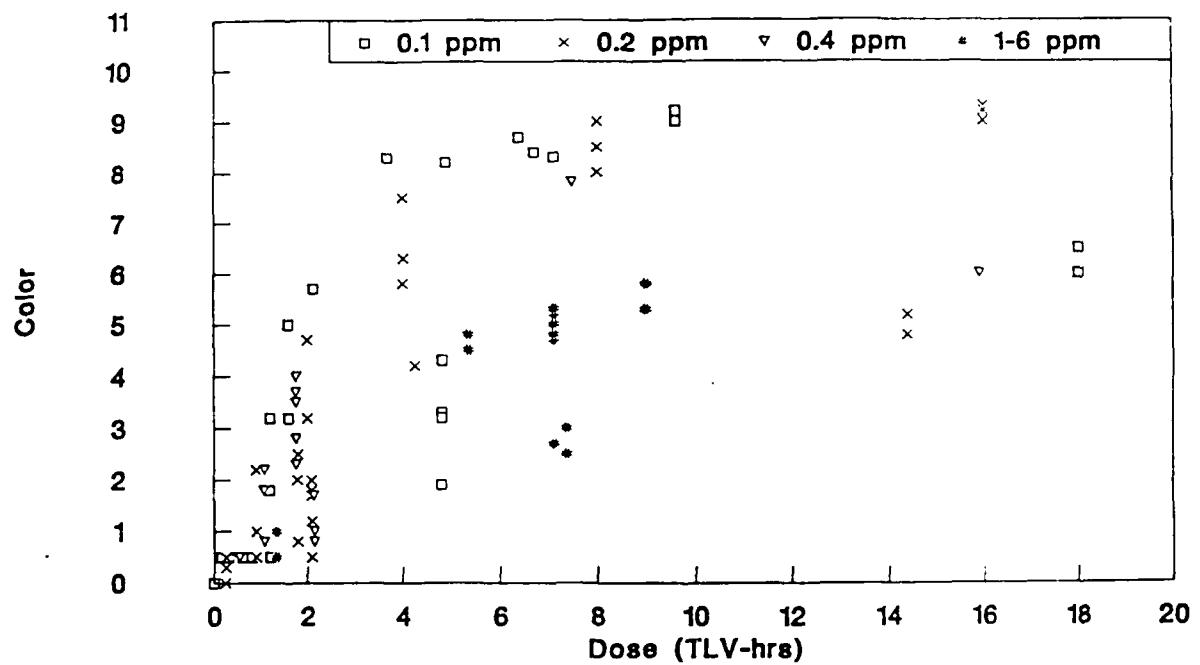


Fig. 6a. MMH Dose Response Curve at T=0 for PDAB (D12) without Diffusion Membrane

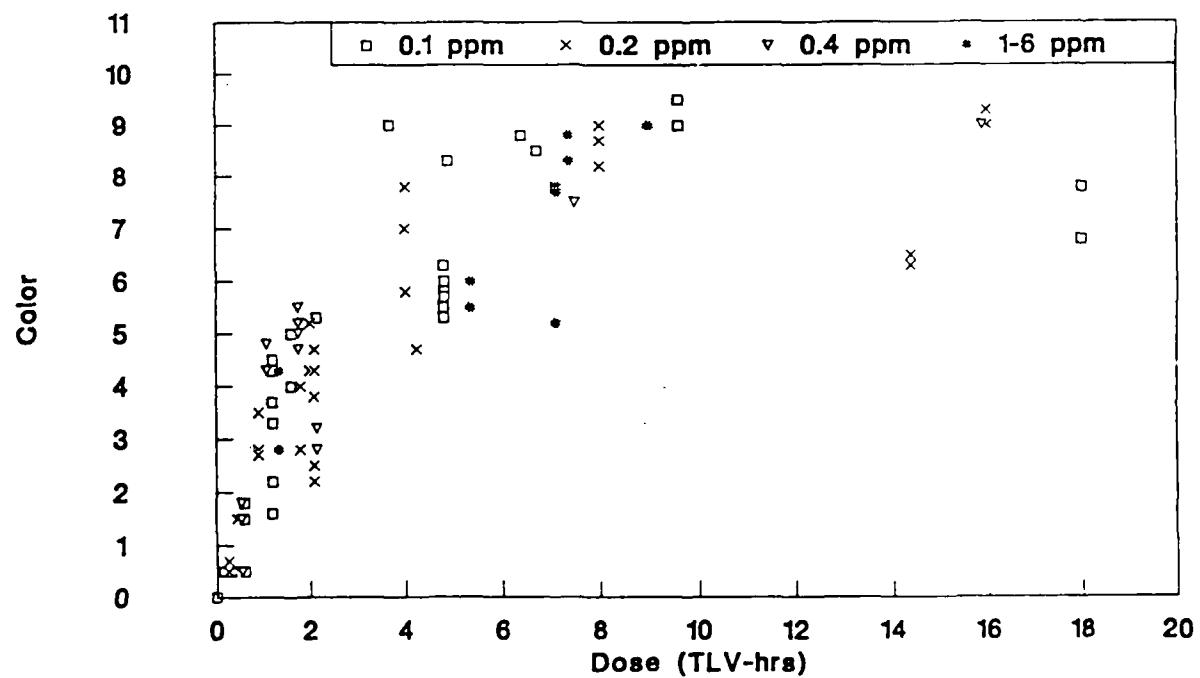


Fig. 6b. MMH Dose Response Curve at T=1 for PDAB (D12) without Diffusion Membrane

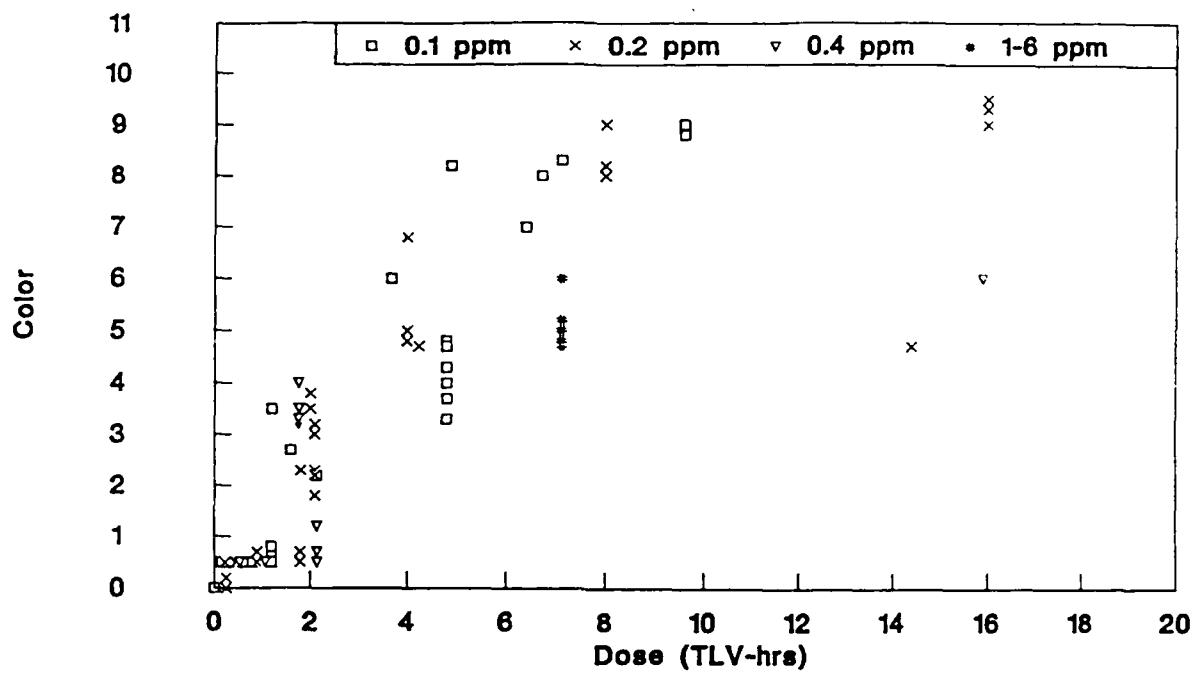


Fig. 6c. MMH Dose Response Curve at T=0 for PDAB (D12) with Diffusion Membrane

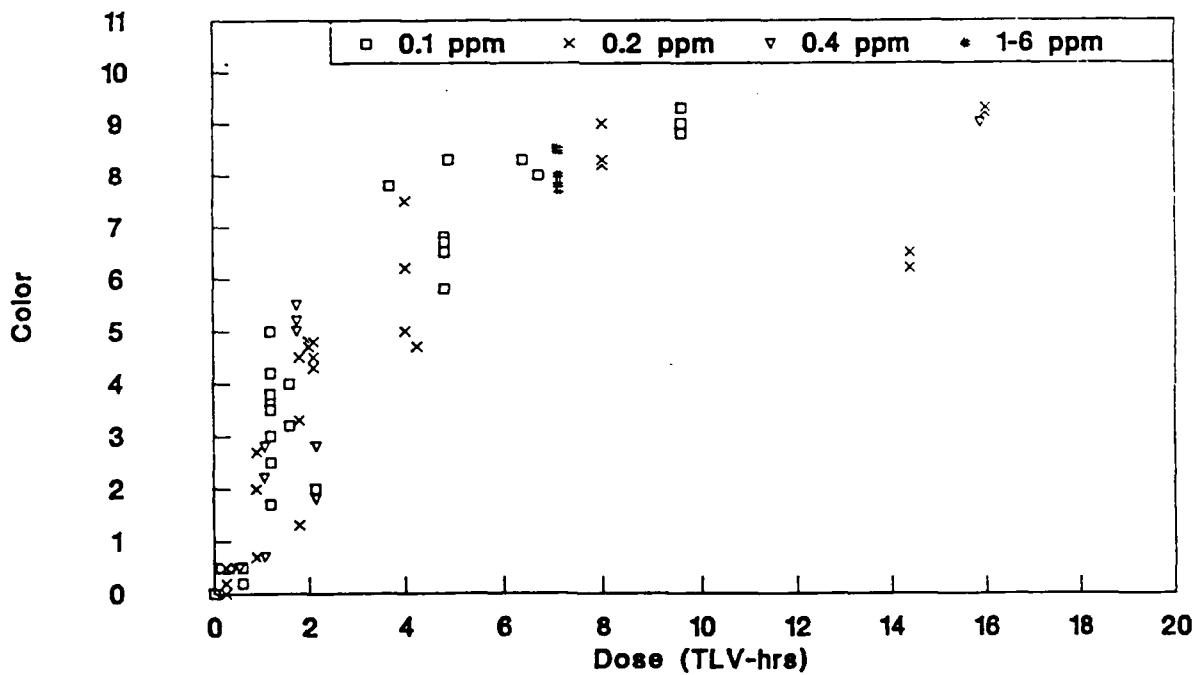


Fig. 6d. MMH Dose Response Curve at T=1 for PDAB (D12) with Diffusion Membrane

development at T=1, badges exposed to 10 TLV-hours appear to reach saturation. At T=0, there is less scatter in the data taken from badges with a diffusion membrane than data from badges without a membrane. However, at T=1, the scatter for both types of badges is comparable.

Time dependence is evident for the vanillin/citric acid (D13) badges without the diffusion membrane. Figures 7a and 7b show the graphs for T=0 and T=1. At T=0, there is scatter at every dose. This is especially true for those exposures obtained at higher concentrations (1-6 ppm) and lower exposure times. These points increase in color significantly by T=1. They are no longer outlying points and have moved onto the response curve. The badges with the diffusion membranes over the top color dot Figures 7c and 7d give a smoother, more linear plot at T=0 than at T=1. There was a slight increase in color saturation between T=0 and T=1. The D13 badges that included the membrane in their design were only exposed to 0.1 and 0.2 ppm MMH. Those badges without the membrane were exposed to the entire range of concentrations stipulated in the test plan. If the data taken from concentrations of 0.4 and 1-6 ppm is disregarded for a direct comparison between the two types of badges, the scatter in both is comparable. The membrane has little effect on the color produced at any particular dose.

The vanillin/phosphoric acid (D14) badges without the diffusion membrane exhibit a slight color development time dependence. The outlying data points present at T=0 show the greatest increase in color by T=1. The curve looks smoother an hour after exposure. Several of the outlying points represent exposures to high MMH concentrations. Saturation occurs at 16 TLV-hours. Dose response plots of this data are found in Figures 8a and 8b. The badges with the membrane show little increase in color from T=0 to T=1. As shown in Figures 8c and 8d, there is much scatter at <2.5 TLV-hours as noted previously. Saturation occurs between 6 to 8 TLV-hours with a color of 9.5. The use of a diffusion membrane does not have an effect on the development of color. Both badges, with and without the membrane, develop comparable intensities of color.

In addition to each of the individual chemistry badges, a composite badge incorporating the vanillin and the PDAB (D13+D12) was designed. The same badge design was used incorporating one chemistry in each position. The diffusion membrane was not used. Dose response data for vanillin on the composite badges is shown in Figures 9a and 9b. The color development for vanillin increases from T=0 to T=1. With the exception of a few outlying data points, there is the same amount of scatter at both readings of the badge. Those points obtained at higher concentrations of the MMH show the greatest increase in color. Color saturation occurs at 10 TLV-hours. The vanillin color dot on the composite badges is slightly more sensitive to MMH than the noncomposite D13 badges.

Except for a few outlying points, the response curve is very smooth at T=0 and T=1 for the composite PDAB (Figures 9c and 9d). Almost all of the outliers have moved up into the linearity curve with increased color by T=1. Saturation occurs at 9 TLV-hours with a color of 9.5. The PDAB color dot on the composite badges is much more stable than the PDAB color dot on the noncomposite badges. The sensitivity to MMH is comparable for both badges. Incorporating the two chemistries on the same badge may permit each to influence the performance of the other.

The composite badges D12+D14, which were produced late in the test program, are PDAB and vanillin/phosphoric acid. PDAB was coated on the top of the dosimeter, while the

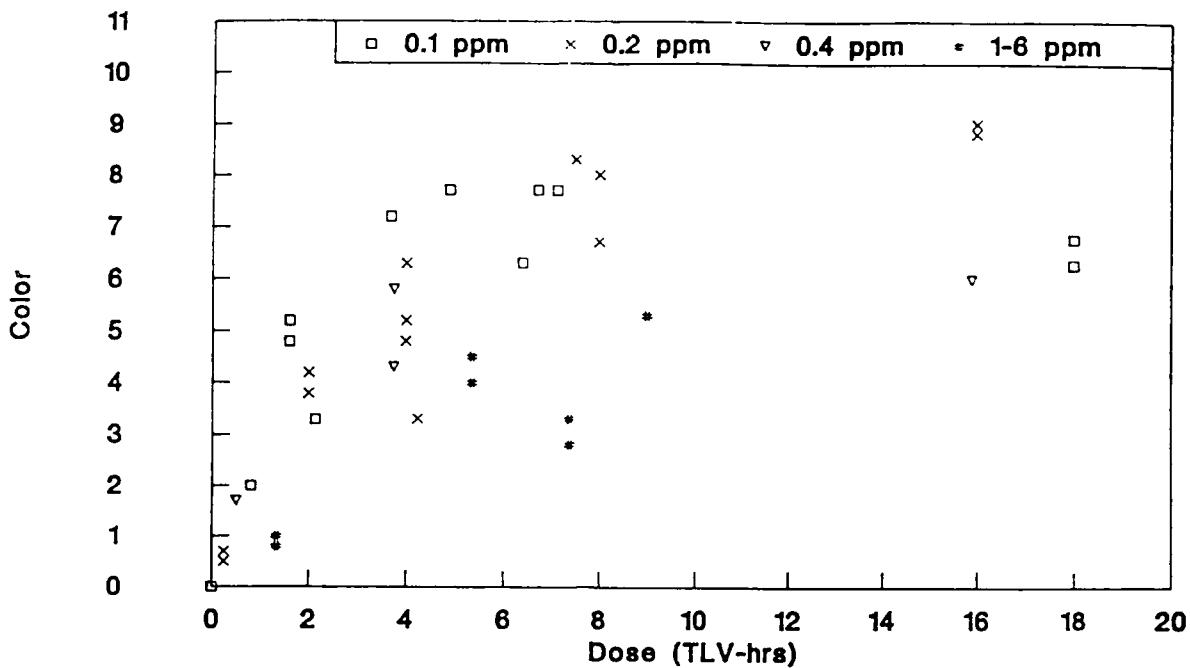


Fig. 7a. MMH Dose Response Curve at T=0 for Vanillin (D13) without Diffusion Membrane

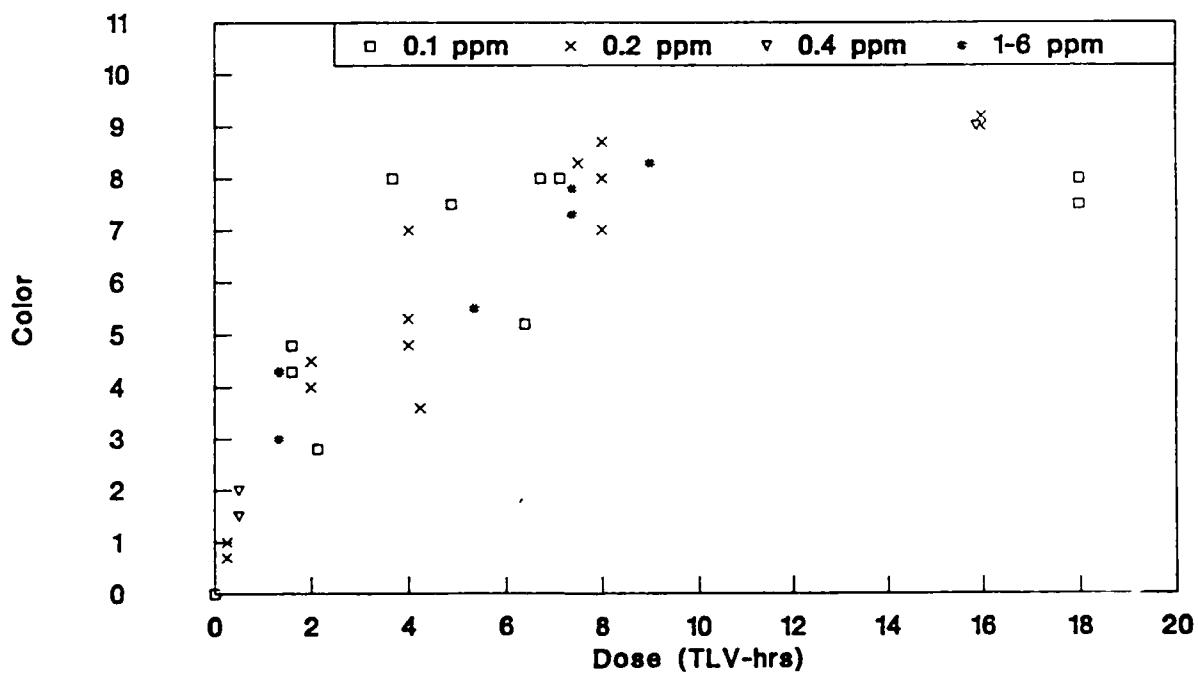


Fig. 7b. MMH Dose Response Curve at T=1 for Vanillin (D13) without Diffusion Membrane

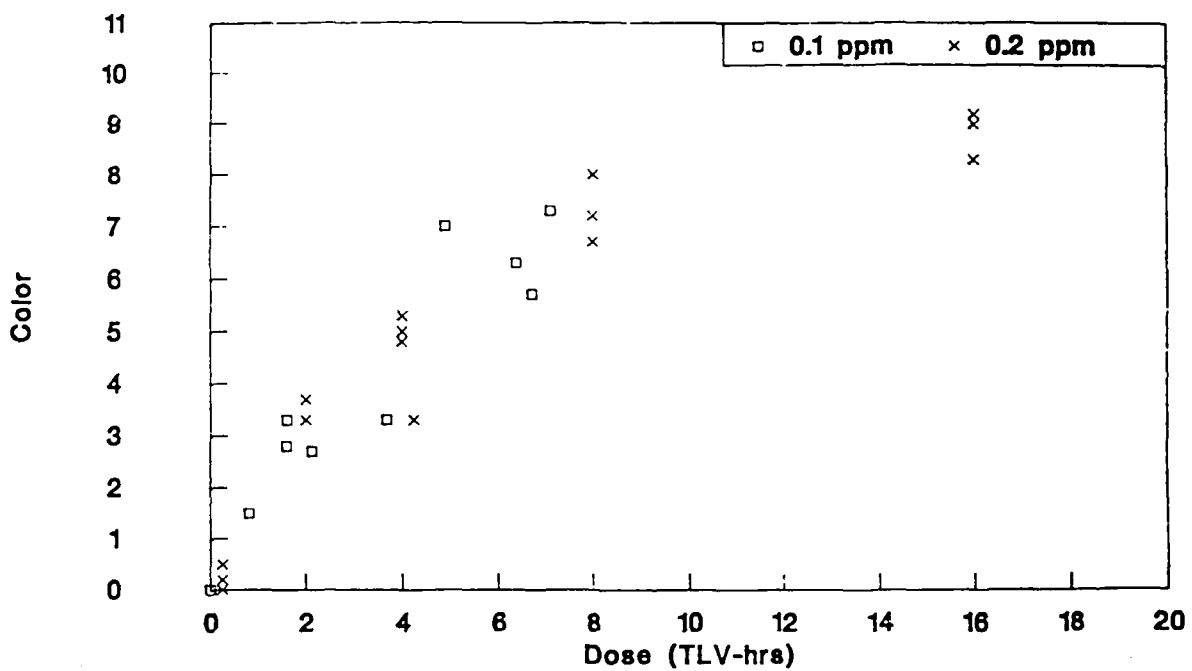


Fig. 7c. MMH Dose Response Curve at $T=0$ for Vanillin (D13) with Diffusion Membrane

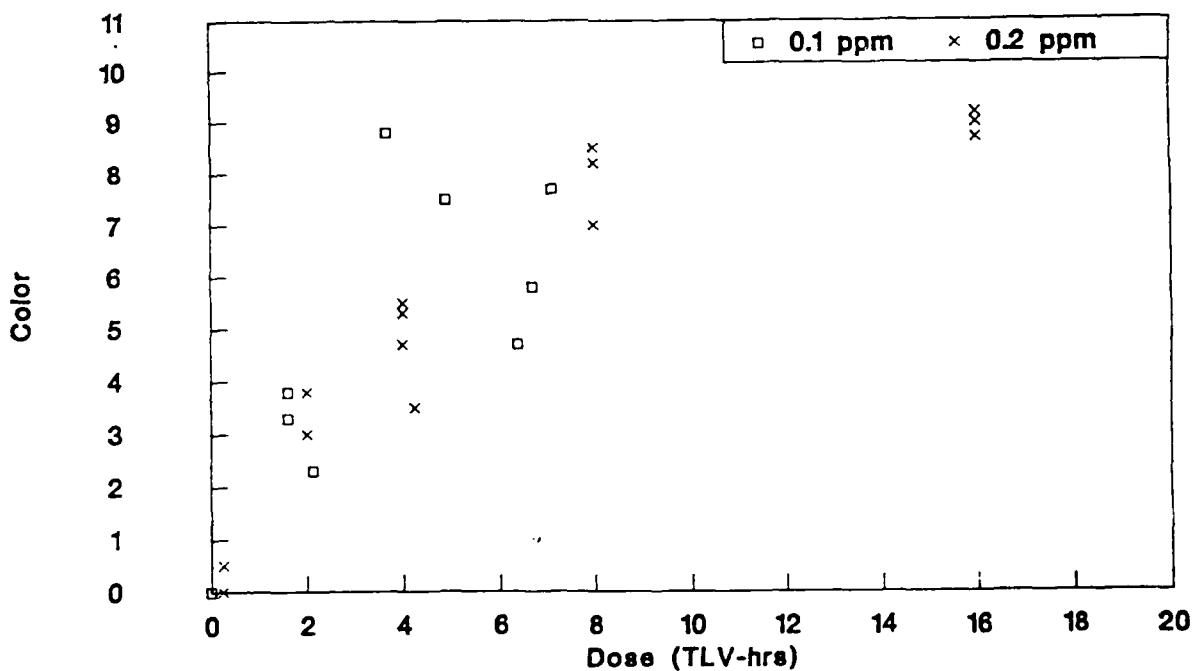


Fig. 7d. MMH Dose Response Curve at $T=1$ for Vanillin (D13) with Diffusion Membrane

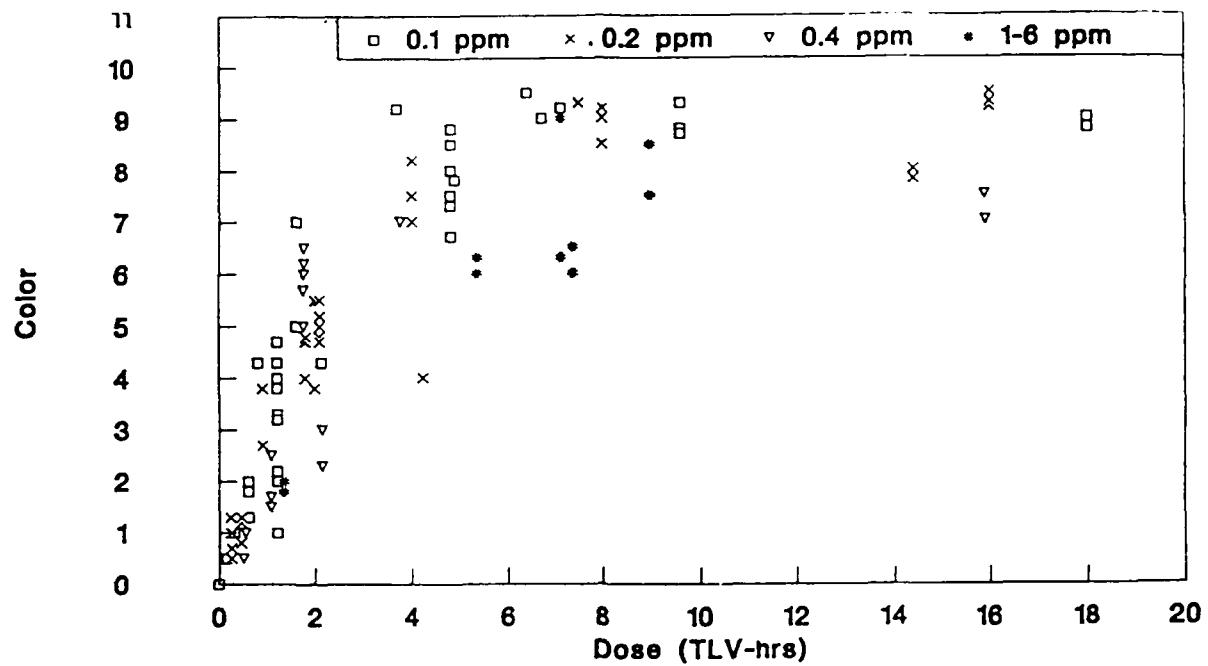


Fig. 8a. MMH Dose Response Curve at T=0 for Vanillin (D14) without Diffusion Membrane

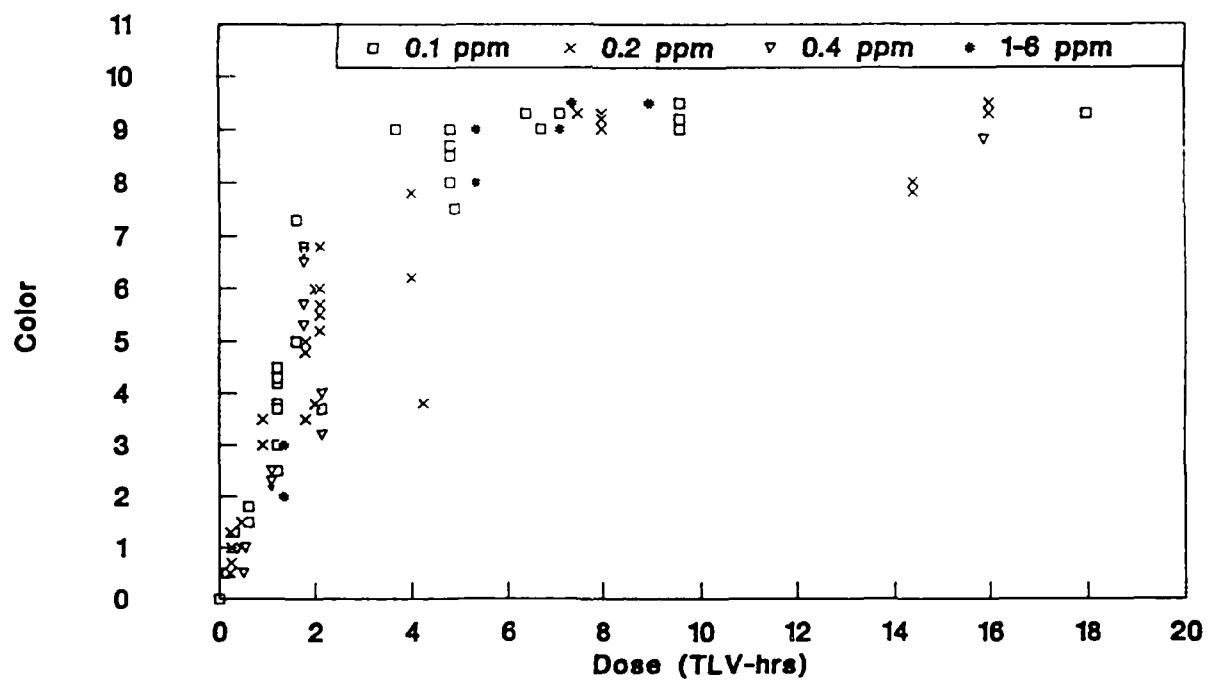


Fig. 8b. MMH Dose Response Curve at T=1 for Vanillin (D14) without Diffusion Membrane

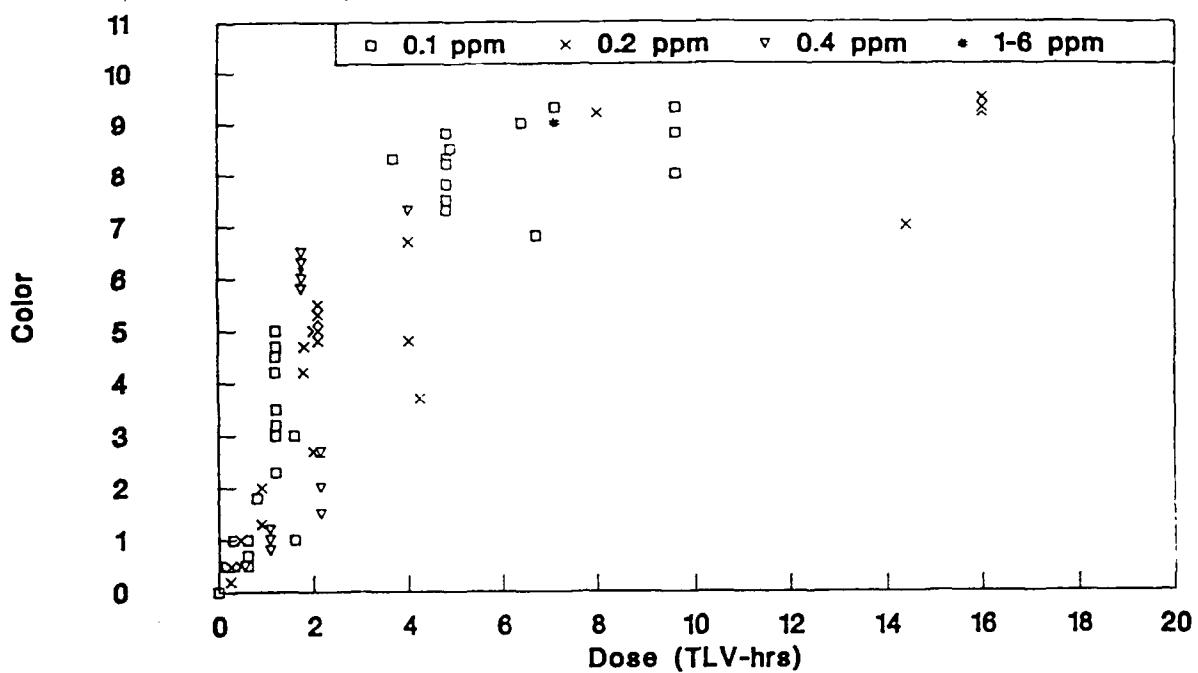


Fig. 8c. MMH Dose Response Curve at $T=0$ for Vanillin (D14) with Diffusion Membrane

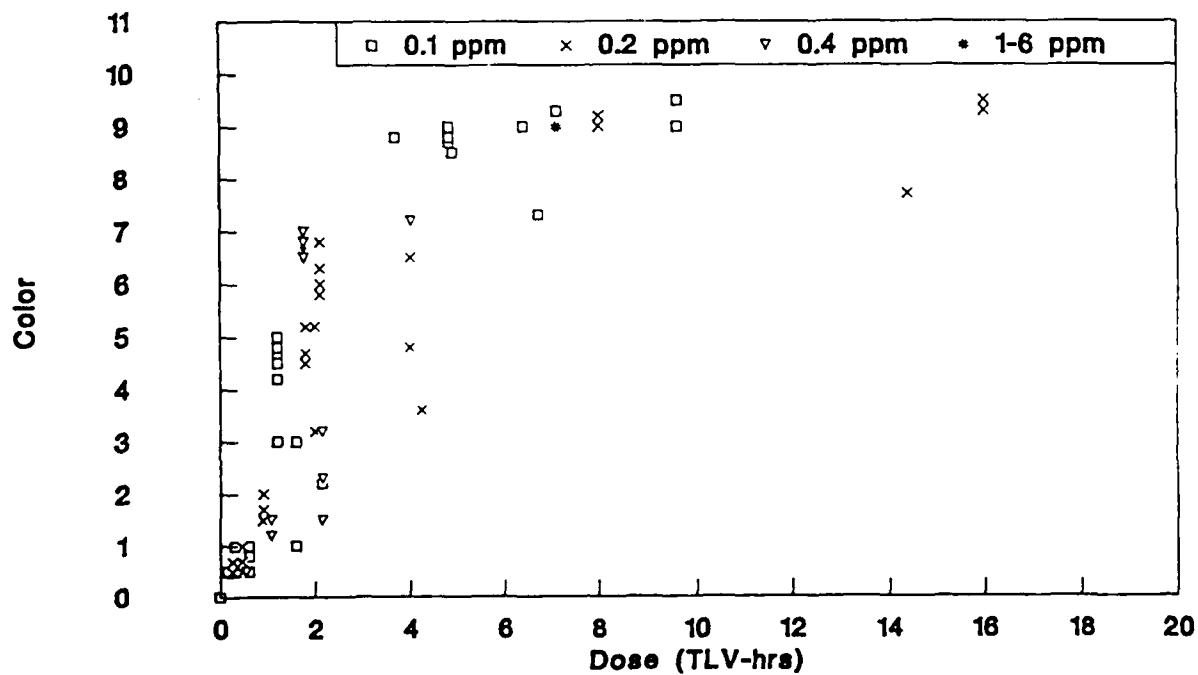


Fig. 8d. MMH Dose Response Curve at $T=1$ for Vanillin (D14) with Diffusion Membrane

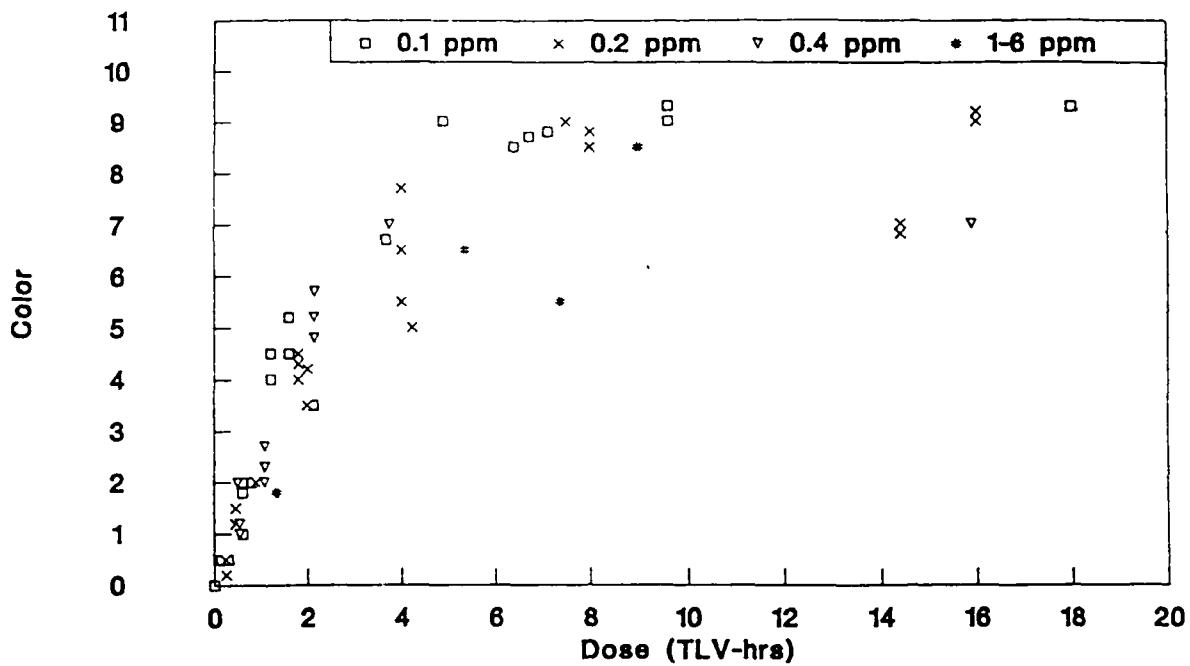


Fig. 9a. MMH Dose Response Curve at $T=0$ for Vanillin (D13, D13+D12)

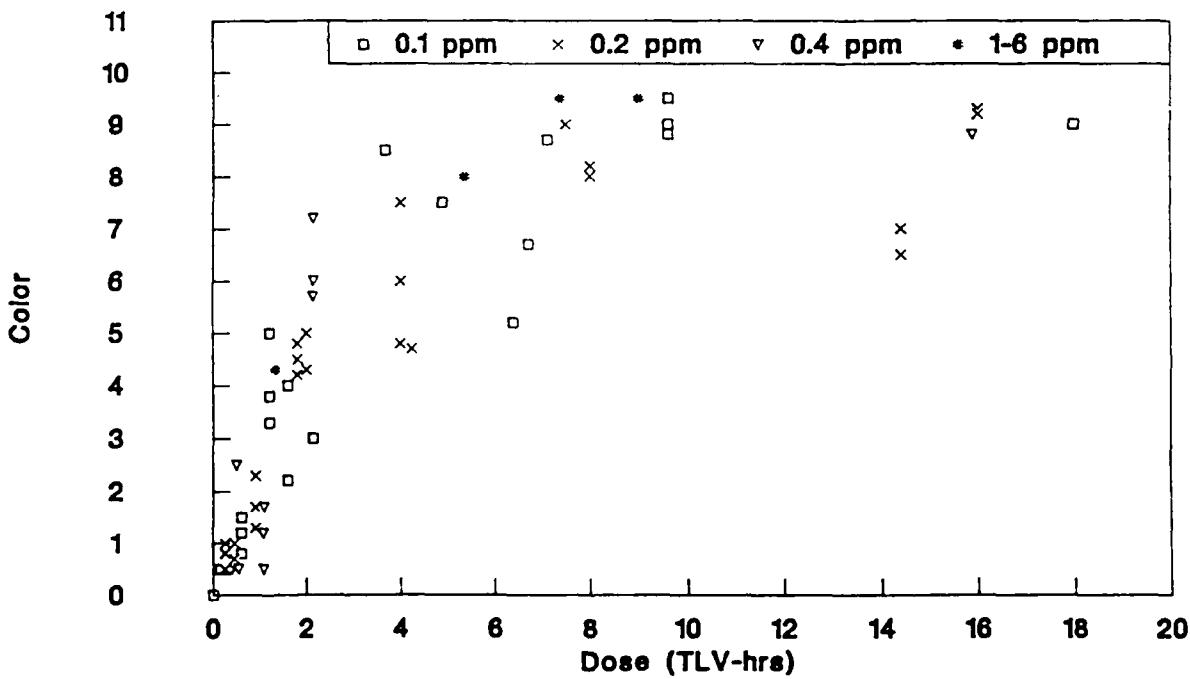


Fig. 9b. MMH Dose Response Curve at $T=1$ for Vanillin (D13, D13+D12)

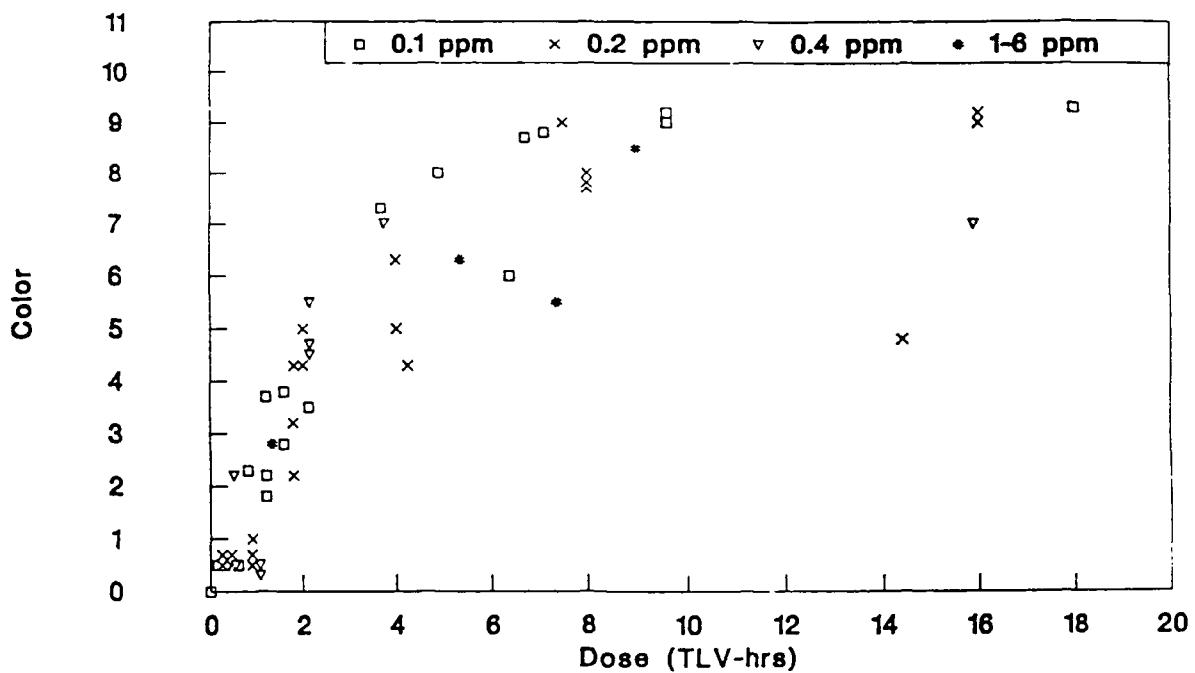


Fig. 9c. MMH Dose Response Curve at $T=0$ for PDAB (D12, D13+D12)

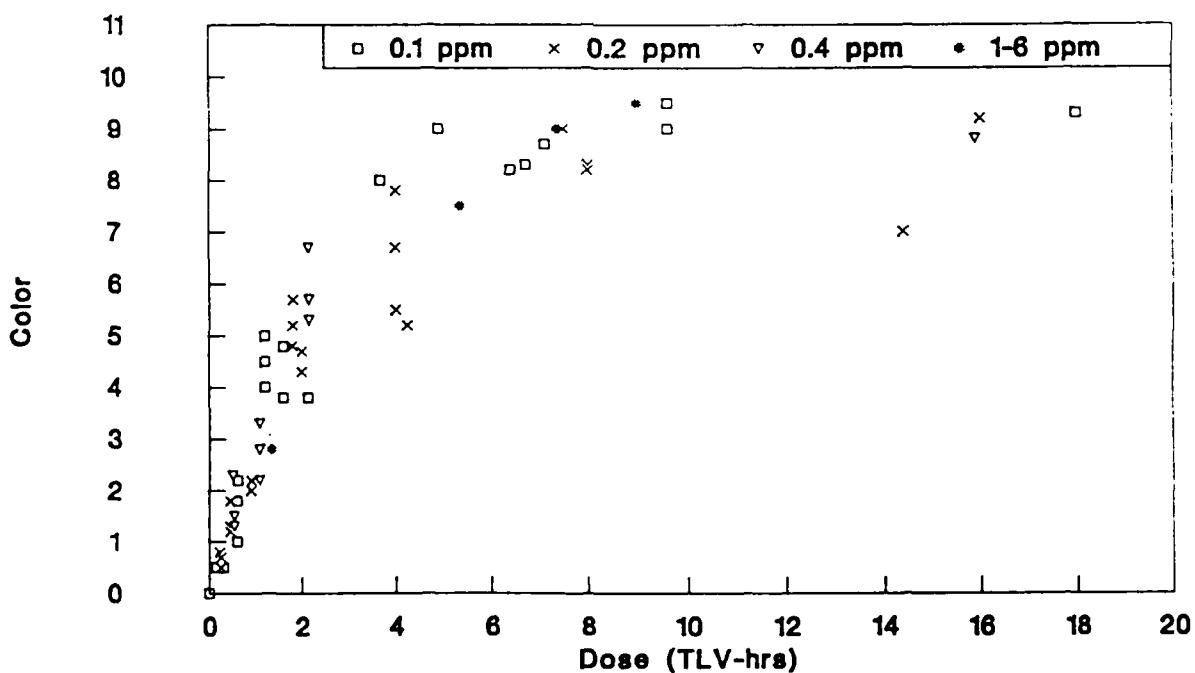


Fig. 9d. MMH Dose Response Curve at $T=1$ for PDAB (D12, D13+D12)

vanillin/phosphoric acid was coated on the bottom. These badges were tested at doses up to 15 TLV-hours with concentrations of MMH ranging from 0.15 ppm to 1.0 ppm. They were evaluated with the color wheel consisting of colors 1-5. There is an increase in color from T=0 to T=1 for both PDAB and vanillin. However, this time dependence is much pronounced in the PDAB badges. The scatter evident at T=0 is less so at T=1. Vanillin reached saturation by 15 TLV-hours with a color of 5.5. There are no data points between 2 and 15 TLV-hours; therefore, the exact saturation dose was not determined. The PDAB badges reach an average color of 5 by 15 TLV-hours. This data is plotted in Figures 10a-10d.

To compare the two color wheels designed for MMH, several of the composite badges D12+D14 were exposed to MMH and their color development was evaluated with both color wheels. Figures 11a and 11b represent dose response graphs of the PDAB spots on the badges. There was excellent correlation between the color wheels. The vanillin spots were evaluated as well. Figures 11c and 11d show the plots for vanillin. There is very good correlation between the two color wheels for vanillin. There appears to be the same amount of scatter for both vanillin and PDAB regardless of which color wheel is used for evaluation of the badges.

DOSE RESPONSE RESULTS FOR HYDRAZINE

Dose response tests with hydrazine were carried out at the TLV level (0.1 ppm) of hydrazine. Figures 12a-12d give the response data for the badges. PDAB (D12) shows a time dependence at doses less than 16 TLV-hours. Vanillin (D13) also shows a time dependence at the lower doses. Vanillin (D14) indicates a slight time dependence, while the composite badge (D13+D12) does not show this trend. The color change shows a good correlation with dose; however, there is not enough data to make conclusions on the precision or the saturation point.

Most of the data collected for exposure to hydrazine were obtained from the composite PDAB and vanillin/phosphoric acid (D12+D14) badges produced for use with the new color wheel. This data provides a more complete picture of the dose response of the badges for hydrazine. The data is represented in Figures 13a-13d. The saturation point at T=0 is between 3 to 3.5 TLV-hours for the PDAB. More data is needed to determine the saturation dosage for vanillin. Saturation color for the PDAB is 3.5. There is a slight time dependence in the PDAB data and a fair amount of scatter below one TLV-hour. The curve for PDAB shows slightly greater sensitivity for hydrazine than MMH at T=0. Vanillin, however, is more sensitive to MMH than hydrazine.

RELATIVE HUMIDITY RESULTS

When exposed to MMH at different relative humidities, badges D12, D13, and D14 were not affected in any consistent way. At <1.0 TLV-hours, the composite badge D13+D12 shows a slightly higher response at 70% RH for both D13 and D12. Limited testing was done with hydrazine at different humidities. When exposed to hydrazine at 70% RH and 40% RH, the composite badge D13+D12 and D14 displayed no effect in color development between the two humidities. At 2 TLV-hours, the D13 and D12 badges showed more intense color development with hydrazine humidified

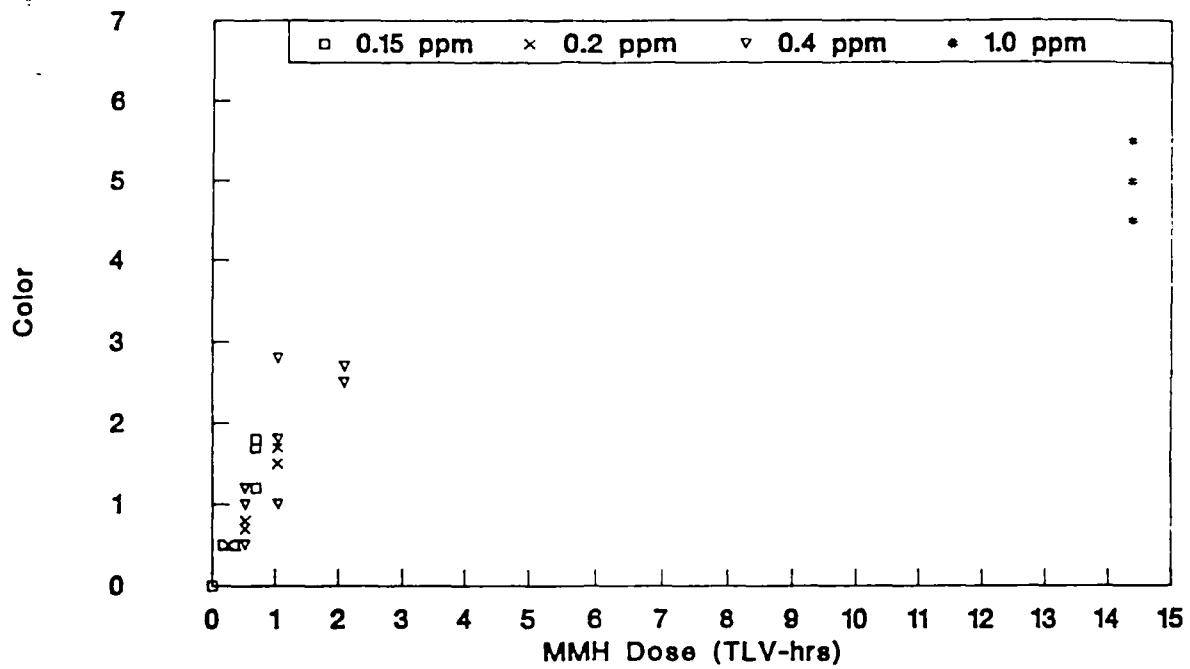


Fig. 10a. MMH Dose Response Curve at T=0 for PDAB (D12, D12+D14)

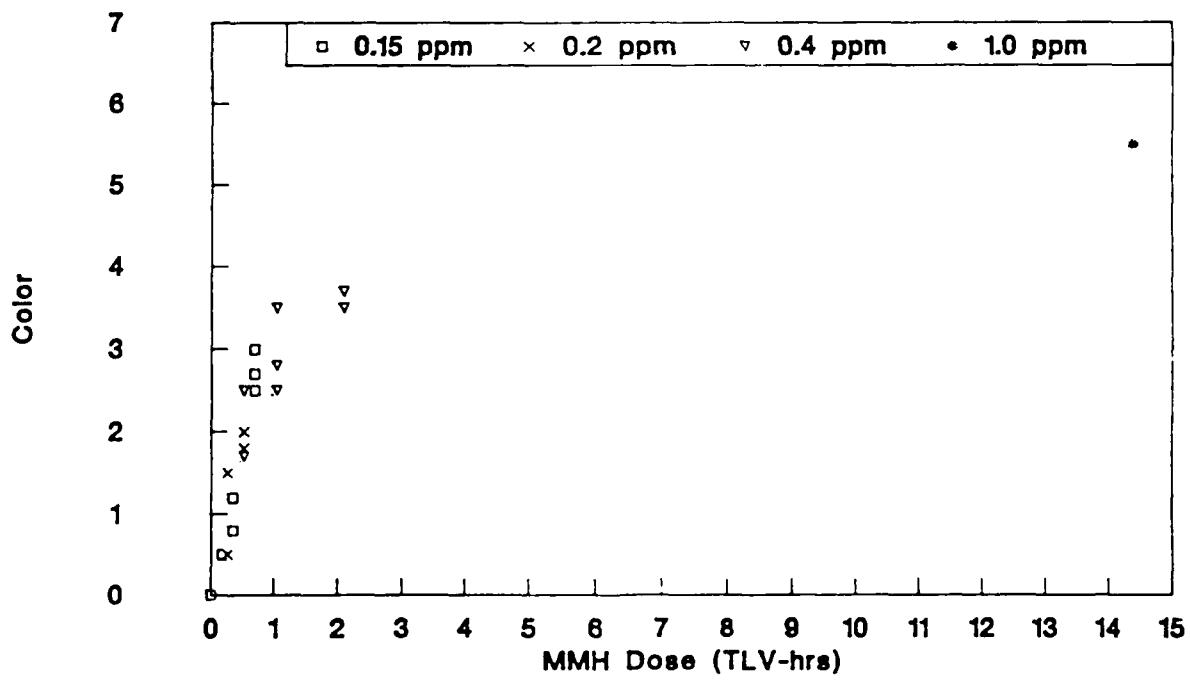


Fig. 10b. MMH Dose Response Curve at T=1 for PDAB (D12, D12+D14)

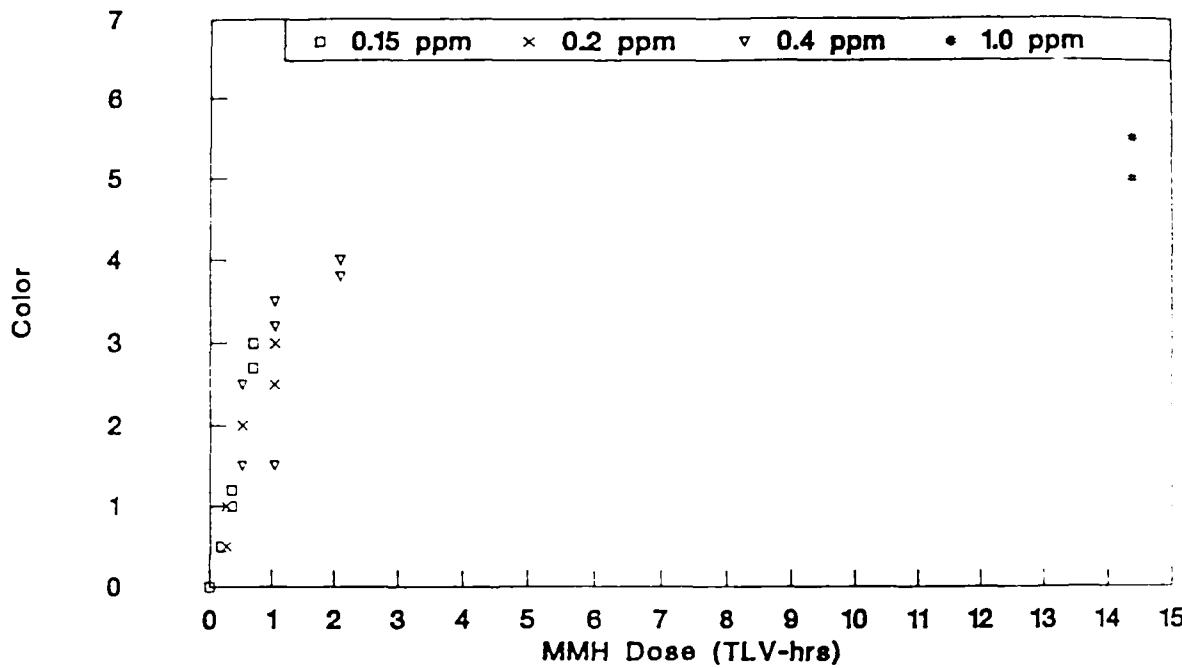


Fig. 10c. MMH Dose Response Curve at $T=0$ for Vanillin (D14, D12+D14)

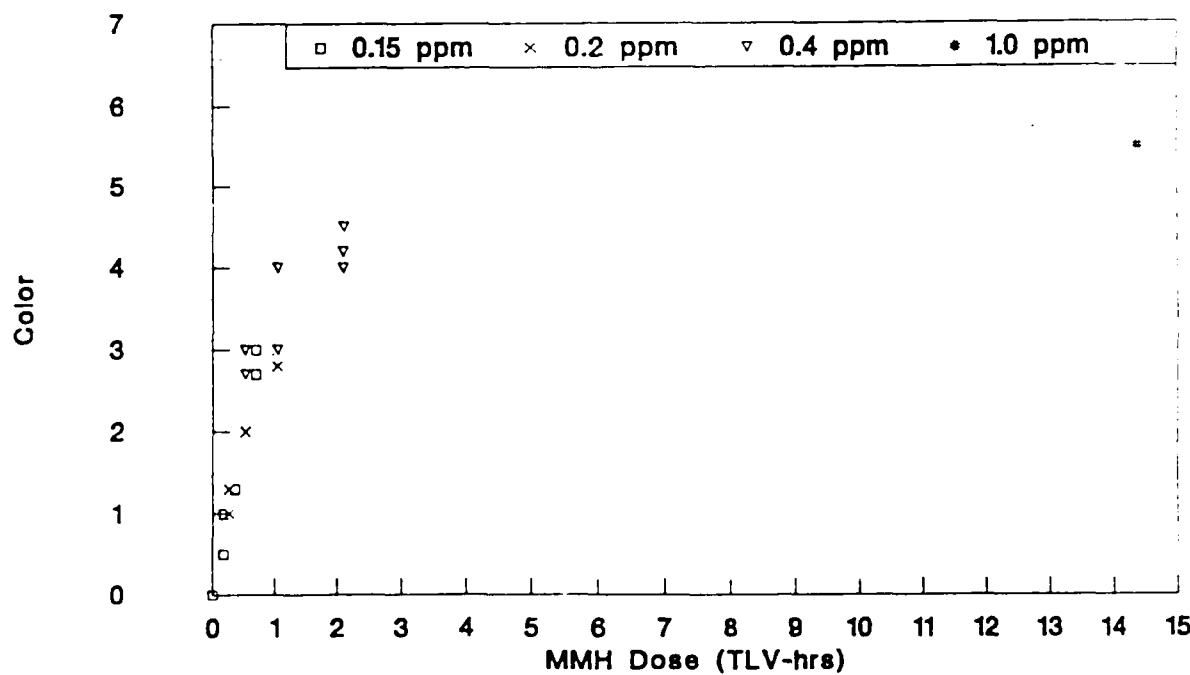


Fig. 10d. MMH Dose Response Curve at $T=1$ for Vanillin (D14, D12+D14)

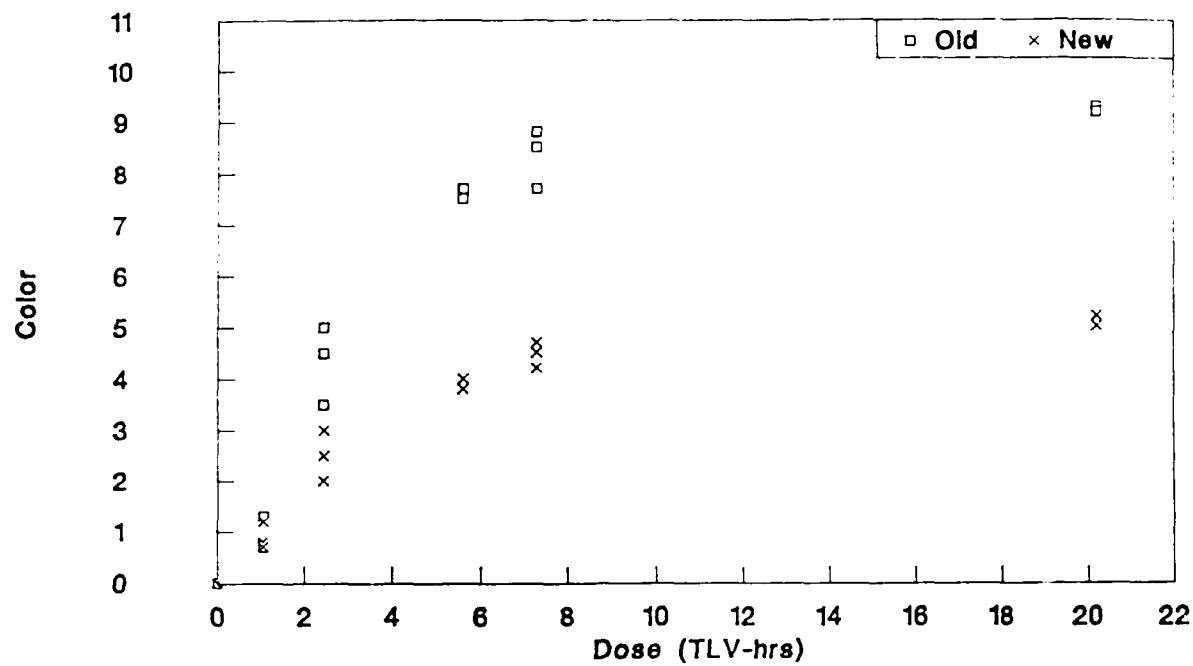


Fig. 11a. Dose Response Comparison Between Old and New PDAB (D12) Color Wheels Using D12+D14 Badge at T=0

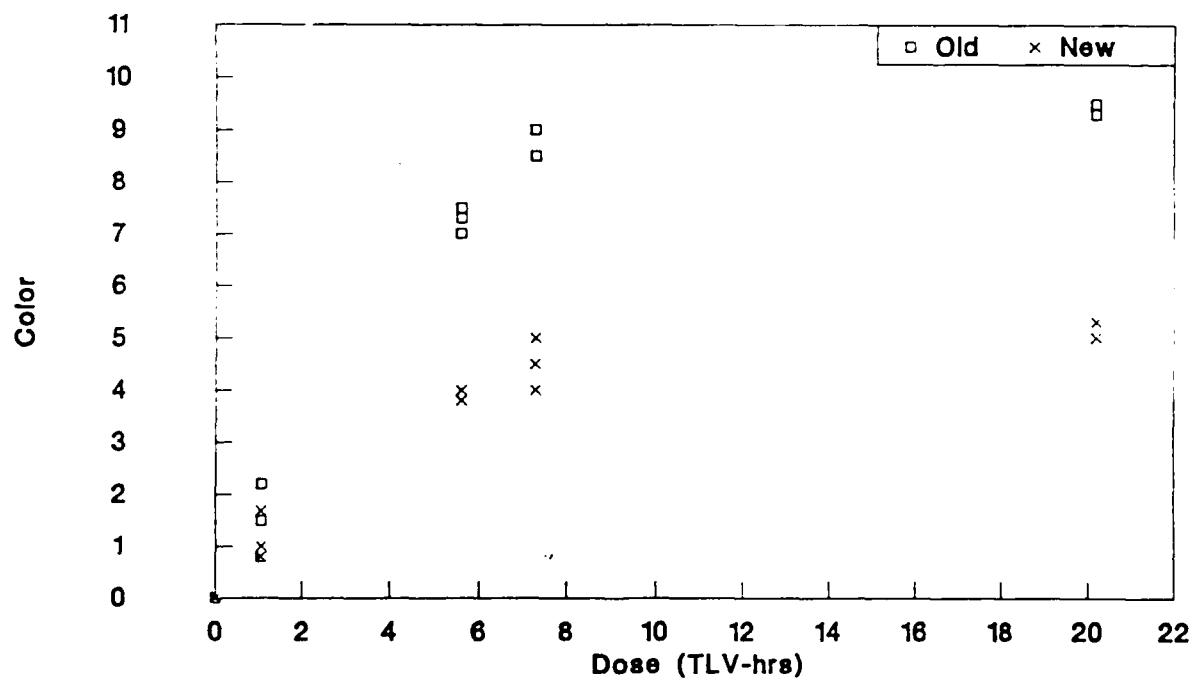


Fig. 11b. Dose Response Comparison Between Old and New PDAB (D12) Color Wheels Using D12+D14 Badge at T=1

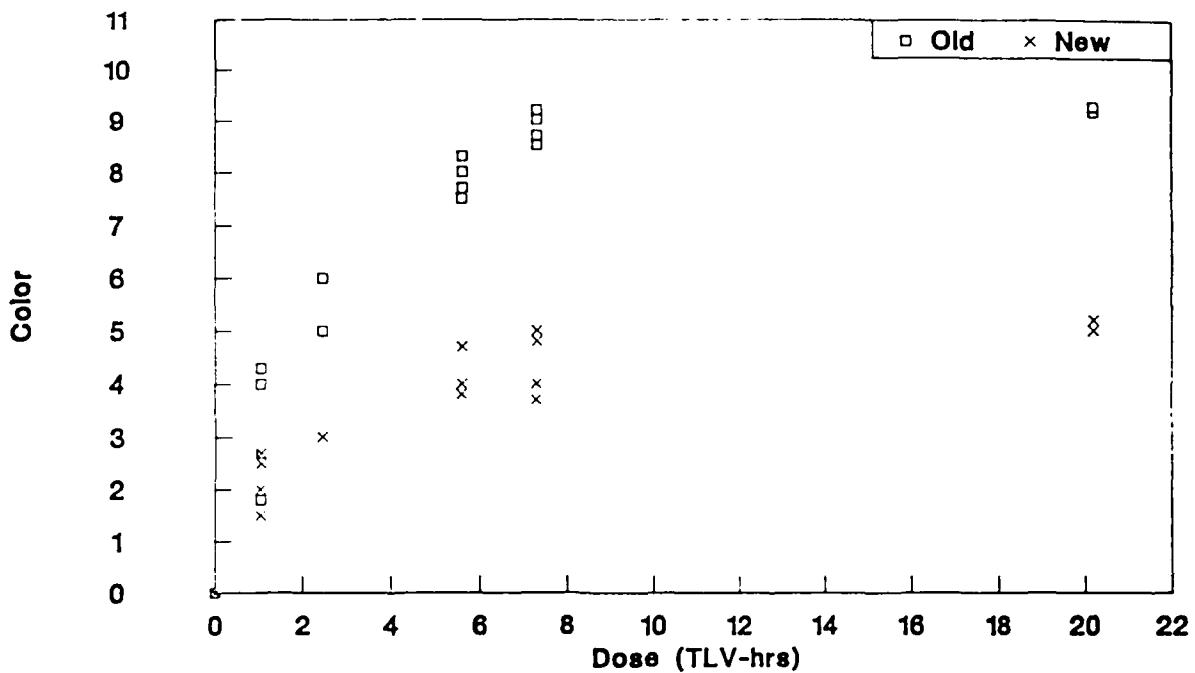


Fig. 11c. Dose Response Comparison Between Old and New Vanillin (D14) Color Wheels Using D12+D14 Badge at T=0

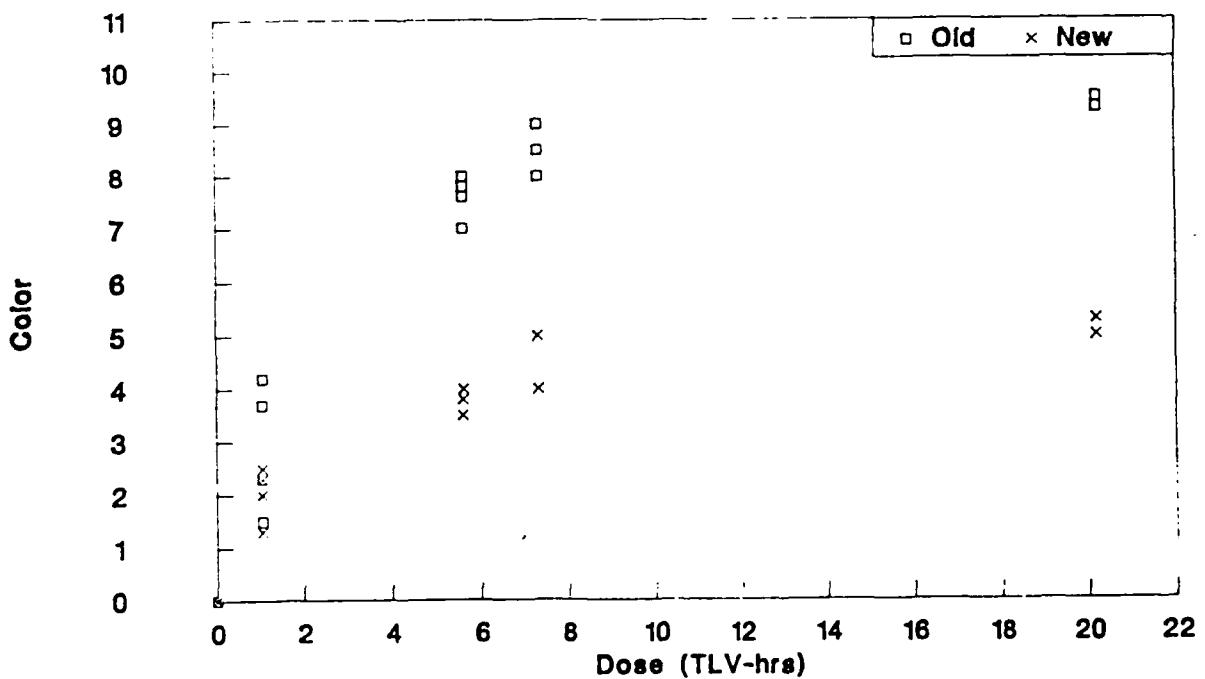


Fig. 11d. Dose Response Comparison Between Old and New Vanillin (D14) Color Wheels Using D12+D14 Badge at T=1

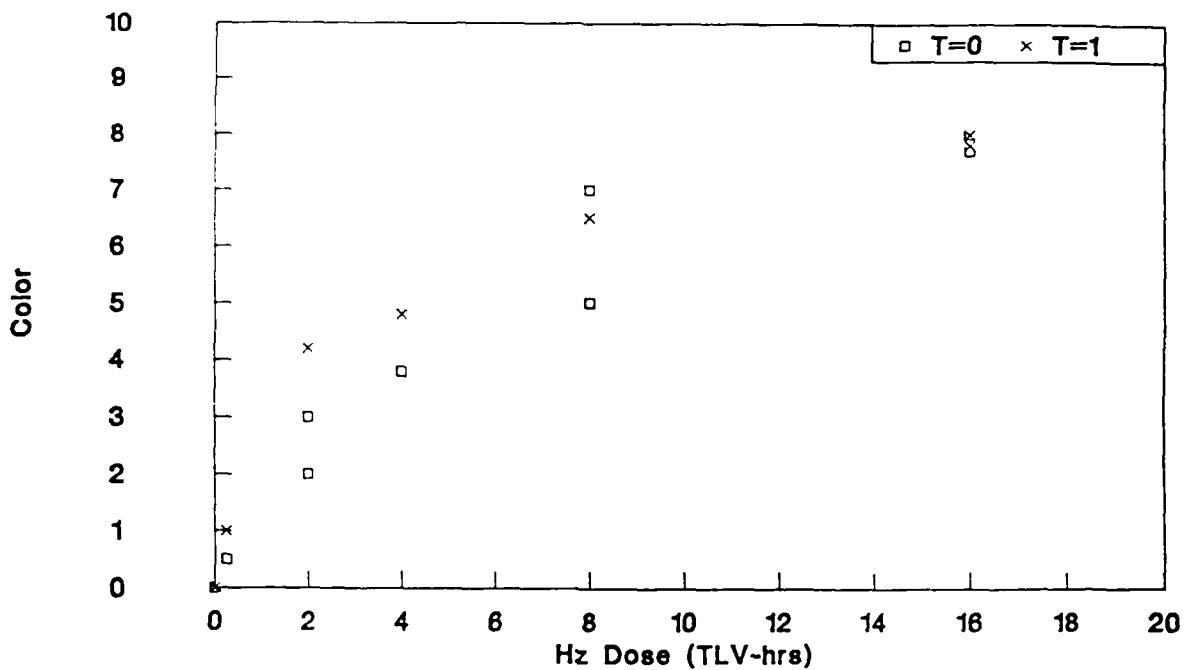


Fig. 12a. Hydrazine Dose Response Curve for PDAB (D12)

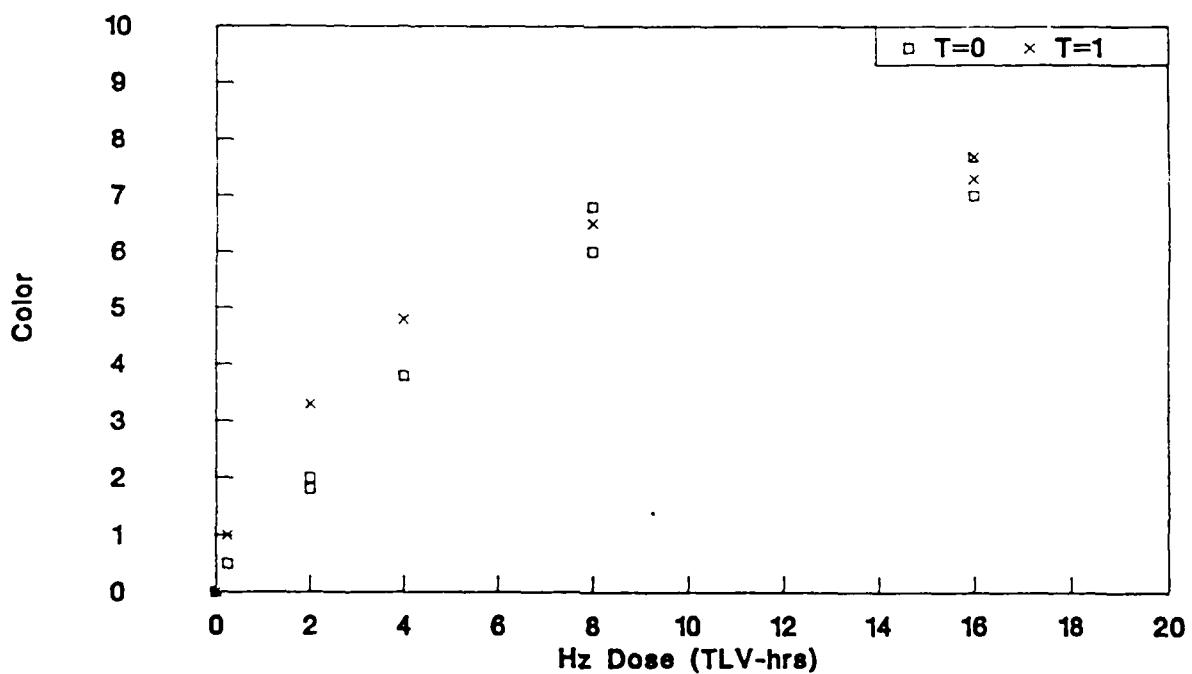


Fig. 12b. Hydrazine Dose Response Curve for Vanillin (D13)

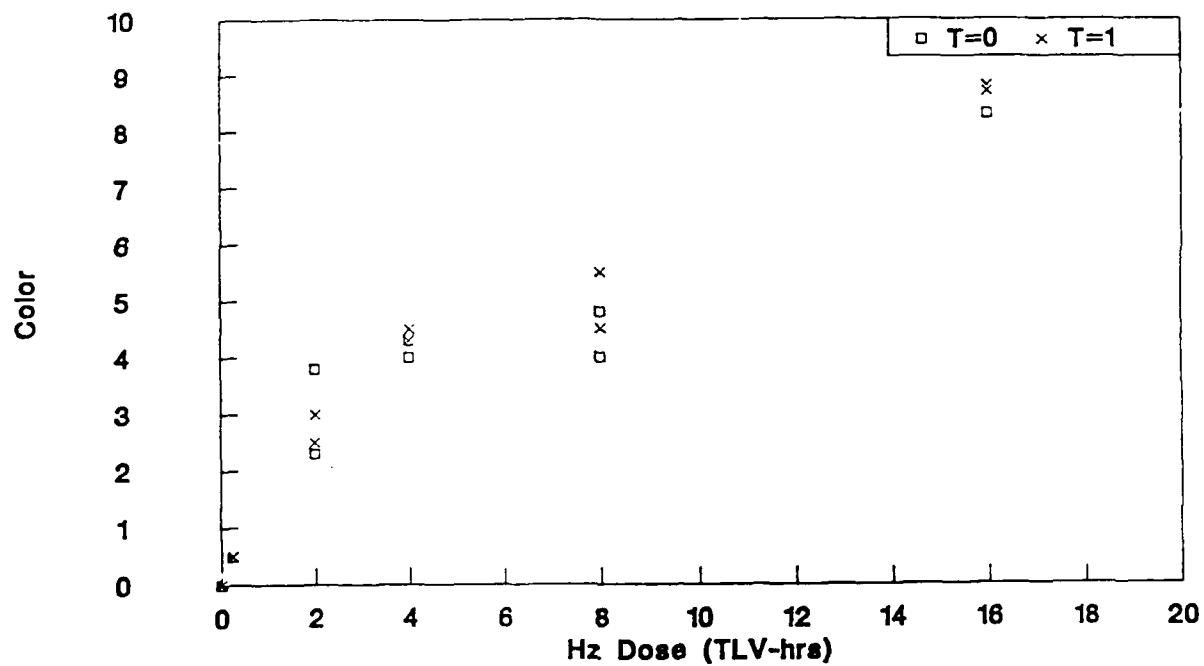


Fig. 12c. Hydrazine Dose Response Curve for Vanillin (D14)

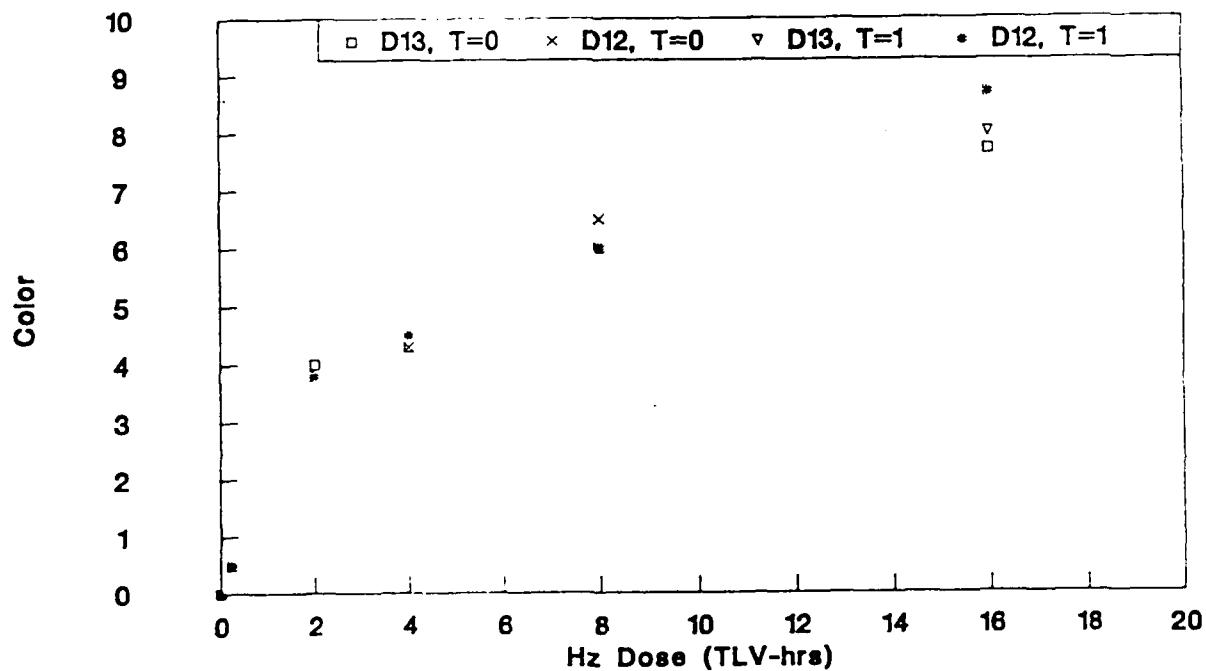


Fig. 12d. Hydrazine Dose Response Curve for Vanillin (D13) and PDAB (D12) Using D13+D12 Badge

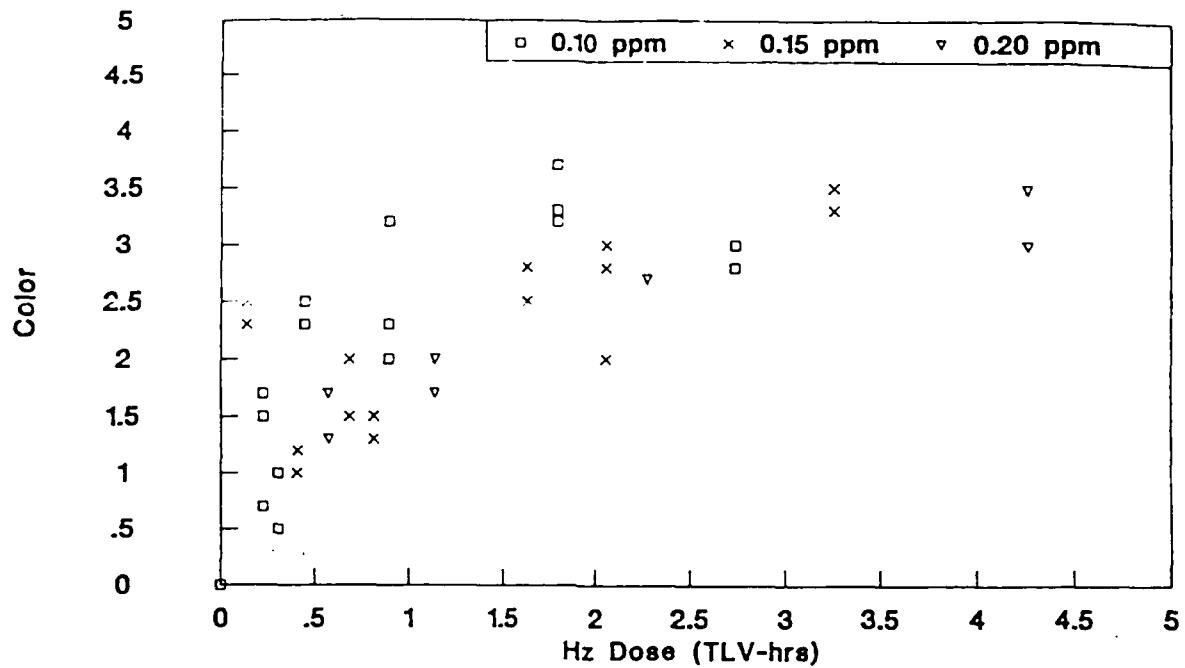


Fig. 13a. Hydrazine Dose Response Curve at T=0 for PDAB (D12, D12+D14)

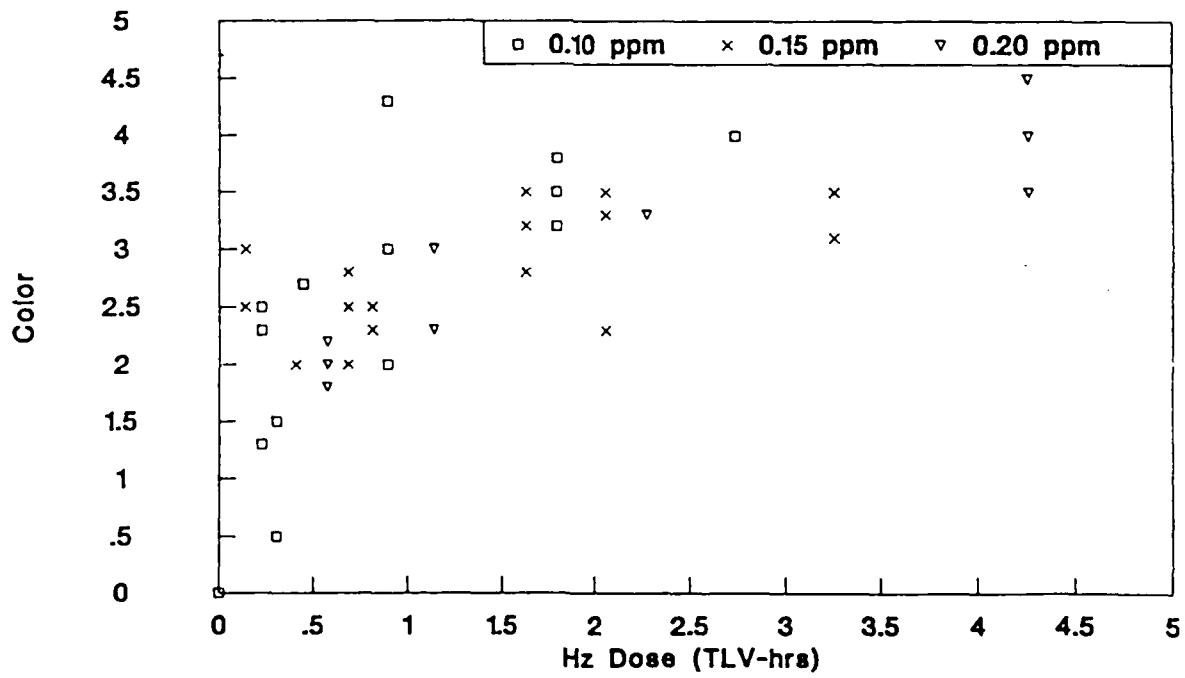


Fig. 13b. Hydrazine Dose Response Curve at T=1 for PDAB (D12, D12+D14)

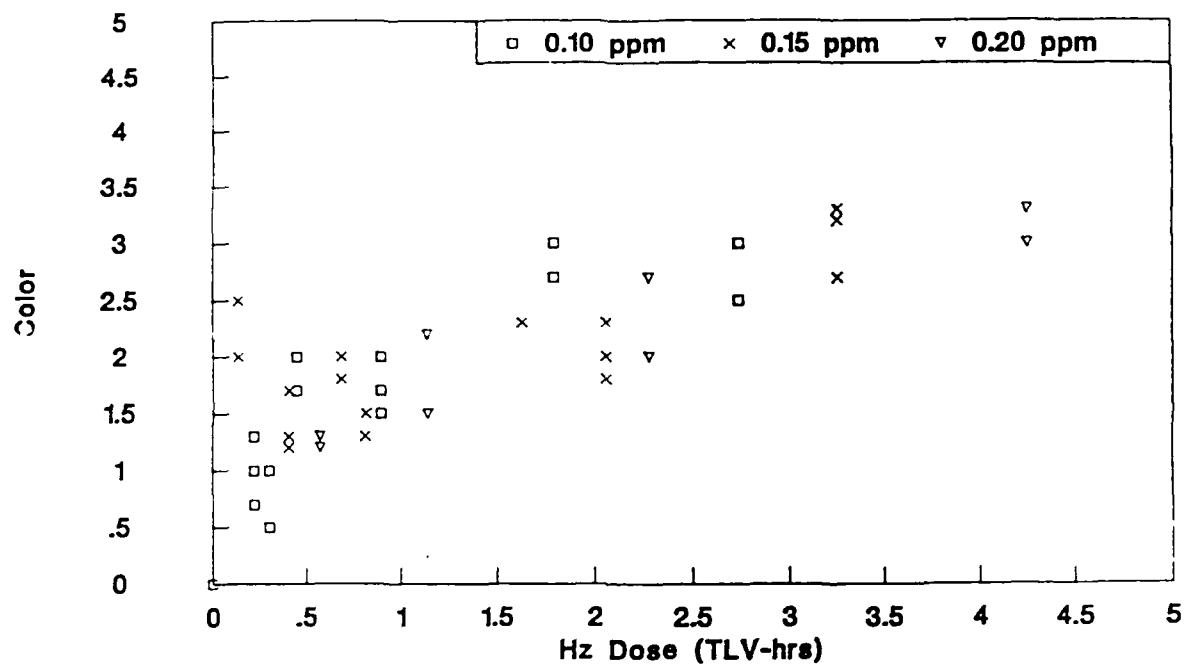


Fig. 13c. Hydrazine Dose Response Curve at T=0 for Vanillin (D14, D12+D14)

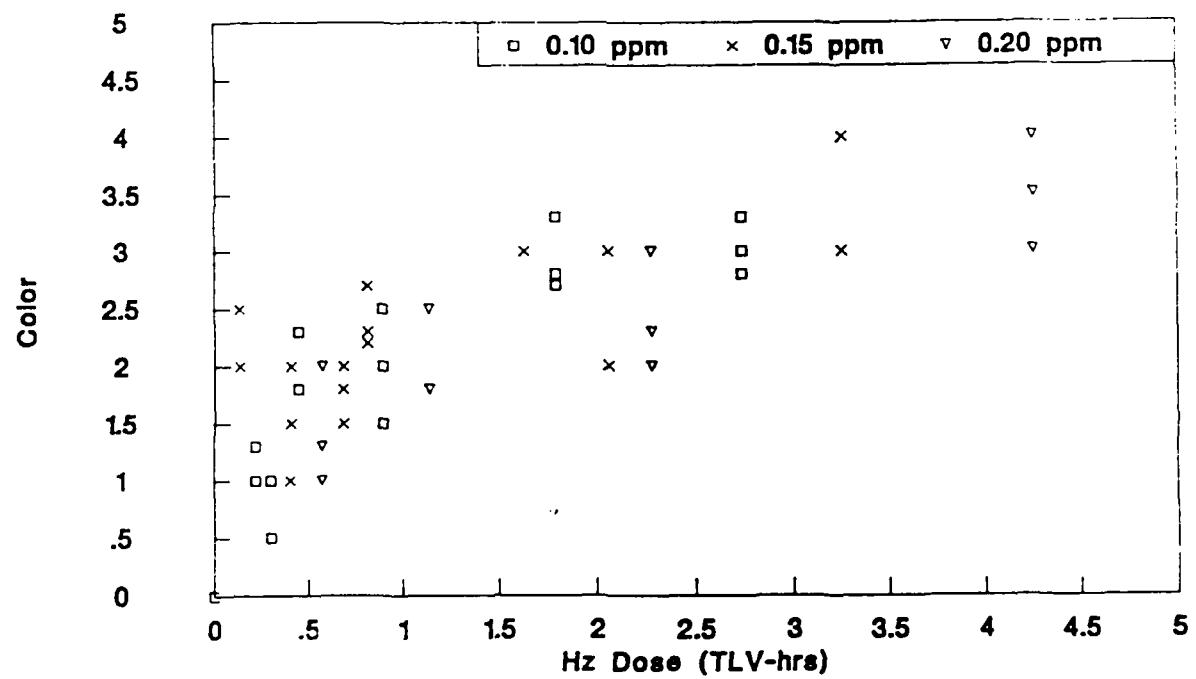


Fig. 13d. Hydrazine Dose Response Curve at T=1 for Vanillin (D14, D12+D14)

to 70% RH than at 40%. However, more data points would be needed for statistical certainty. The data for RH effects on MMH is compiled in Tables 4a-4d. The responses are given by dose and humidity as well as the location of the spot on the badge (top or bottom).

For dosimeters D12, D13, D14, and the composite D13+D12, there is limited data on humidity effects for hydrazine. Table 5 gives the color intensity averages for the two humidities tested. There is not a consistent trend due to humidity for any of the badge types.

Composite badges D12+D14 were exposed to hydrazine at several humidities. Figures 14a-14d detail the relative humidity trends for the PDAB and vanillin sections of these badges. Vanillin is not affected by differing humidities. PDAB data shows lower color intensity for badges exposed to <10% RH at T=0. However, at T=1, the badges at <10% RH have increased in color intensity and no longer give lower results than the other humidities.

INTERFERENT RESPONSES

All interference tests involving heat, cold, UV light, and sunlight were carried out at Wiltech. Heating the badges was accomplished by placing them in a convection oven at 40°C. Badges exposed to cold temperatures were placed in a freezer. When a UV light source was used, badges were exposed to 254 nm or 350 nm wavelengths of light. Exposure to heat and cold lasted for 4 hours, UV light for 0.5 hour. The composite PDAB and vanillin/phosphoric acid (D12+D14) badges were used and evaluated with the 1-5 color wheel. The badges were exposed to heat, cold, and UV light both before and after exposure to MMH. The badges were exposed to sunlight prior to MMH exposure. Table 6 gives the color development of the badges exposed to MMH prior to these interferents. Table 7 shows color development for badges exposed to the interferents first, MMH second. The PDAB badges exposed to sunlight or a UV lamp were evaluated on the vanillin color wheel after interferent exposure as the color development was yellow.

Table 6 shows the interferent data in which the badges were exposed to MMH before the interferents. The colors of the badges were less intense than normal after exposure to MMH and prior to heat exposure. After subsequent exposure to heat, the increase in color brought the badges closer to the normal color intensity. Both PDAB and vanillin were affected by the addition of heat.

When the badges were exposed to heat for 2 hours before exposure to MMH, (Table 7) they showed a minimal color development. The average colors achieved after exposure to both heat and MMH, are less intense than the normal color development for 2.1 TLV-hours of MMH. The colors of both chemistries were less intense than the final colors achieved from exposure to MMH and then heat.

Exposure to cold temperatures after MMH exposure caused no significant changes in the color intensity of either badge. When the badges were exposed to MMH after 2 hours of cold temperatures, they behaved similarly to the heat interference. There was a minimal color development to the cold (0.5) and the badges achieved similar color intensities with the subsequent exposure to MMH. The final average colors were less intense than the colors normally achieved after

Table 4a. Humidity Response of PDAB Badge (D12)

Dose (TLV-hrs)	Color at 70% RH				Color at 40% RH			
	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.13	0.0	0.4	0.1	0.6	0.25	0.25	0.25	0.5
0.25	0.1	0.4	0.1	0.6	0.1	0.3	0.2	0.6
0.47	0.5	0.5	2.0	1.0	0.5	0.5	0.5	0.5
0.79	0.7	2.0	1.0	2.2	0.5	0.5		
1.13	1.5	2.7	0.9	2.4	0.8	1.4	3.1	3.6
1.36	0.8	1.0	2.0	3.3	1.0	0.5	4.3	2.8
2.0	2.0	4.3	2.3	3.4	3.2	4.5	3.8	4.9
3.5	5.3	5.5	5.5	6.0	6.0	8.3	7.8	9.0
11.7	9.5	9.5	9.5	9.5				

Table 4b. Humidity Response of Vanillin Badge (D13)

Dose (TLV-hrs)	Color at 70% RH				Color at 40% RH			
	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot
0.0					0.0	0.0	0.0	0.0
0.12	0.1	0.7	0.0	0.5	0.5	0.5	0.5	0.5
0.25	0.3	0.8	0.2	1.1	0.2	0.6	0.3	0.9
0.47	0.5	0.5	0.9	0.8	1.7	1.7	2.0	1.5
0.79	2.0	3.7	2.0	3.3	1.5	2.0		
1.02	1.9	3.6	1.9	3.3	1.2	1.0	3.0	1.8
1.36	0.5	0.5	1.8	1.8	0.8	1.0	3.0	4.3
2.00	3.0	3.9	3.1	4.3	3.2	3.8	3.0	3.8
3.50	5.5	6.0	6.0	6.3	6.0	7.7	7.2	8.0
11.7	9.5	9.5	9.5	9.5				

Table 4c. Humidity Response of Vanillin Badge (D14)

Dose (TLV-hrs)	Color at 70% RH				Color at 40% RH			
	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot
0.00					0.0	0.0	0.0	0.0
0.13	0.2	0.6	0.2	0.6	0.25	0.5	0.25	0.5
0.25	0.6	1.0	0.5	0.9	0.4	0.7	0.6	0.8
0.47	0.8	2.7	1.3	3.0	0.5	0.5	0.5	0.5
0.79	0.8	2.7	1.3	3.0	1.8	4.3		
1.13	1.7	3.5	1.8	3.5	3.2	2.8	3.8	3.4
1.36	4.5	4.8	4.8	4.8	2.0	1.8	3.0	2.0
2.00	3.9	5.0	3.9	5.2	3.5	4.5	3.5	4.5
3.50	5.8	6.0	5.3	6.0	8.3	9.2	8.8	9.0
11.7	8.5	9.0	9.0	9.5				

Table 4d. Humidity Response of Vanillin/PDAB Badge (D13+D12)

Dose (TLV-hrs)	Color at 70% RH				Color at 35% RH			
	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot	T=0 Top	T=0 Bot	T=1 Top	T=1 Bot
0.00					0.0	0.0	0.0	0.0
0.13	0.5	0.3	0.6	0.5	0.5	0.5	0.5	0.5
0.25	0.7	0.6	0.6	0.6	0.6	0.4	0.8	0.6
0.47	0.9	1.7	1.3	1.8	2.2	2.0	2.5	2.3
0.79	3.0	2.2	3.0	2.7	2.3	2.0		
1.13	5.0	3.4	4.9	3.9	1.8	3.2	2.8	3.7
1.36	4.3	4.0	4.0	4.0	2.8	1.8	4.3	2.8
2.00	4.4	4.3	4.3	4.0	4.3	3.7	4.1	4.3
3.50	7.5	8.5	7.3	7.8	7.3	6.7	8.5	8.0
11.7	9.5	9.5	9.5	9.5				

Table 5. Humidity Response of Badges for Hydrazine

Badge	Dose (TLV-hrs)	Color at 70% RH		Color at 40% RH	
		T=0	T=1	T=0	T=1
D12	0.24	0.5	0.8	0.5	1.0
	2.00	4.0	4.5	2.5	4.3
D13	0.24	0.5	0.5	0.5	1.0
	2.00	3.4	4.5	1.9	3.3
D14	0.24	0.5	0.5	0.5	0.5
	2.00	2.9	4.3	3.1	2.8
D13+D12					
D13	0.24	0.5	0.5	0.5	0.5
	2.00	4.0	4.5	4.0	3.8
D12	0.24	0.5	0.5	0.5	0.5
	2.00	2.3	5.0	3.8	3.8

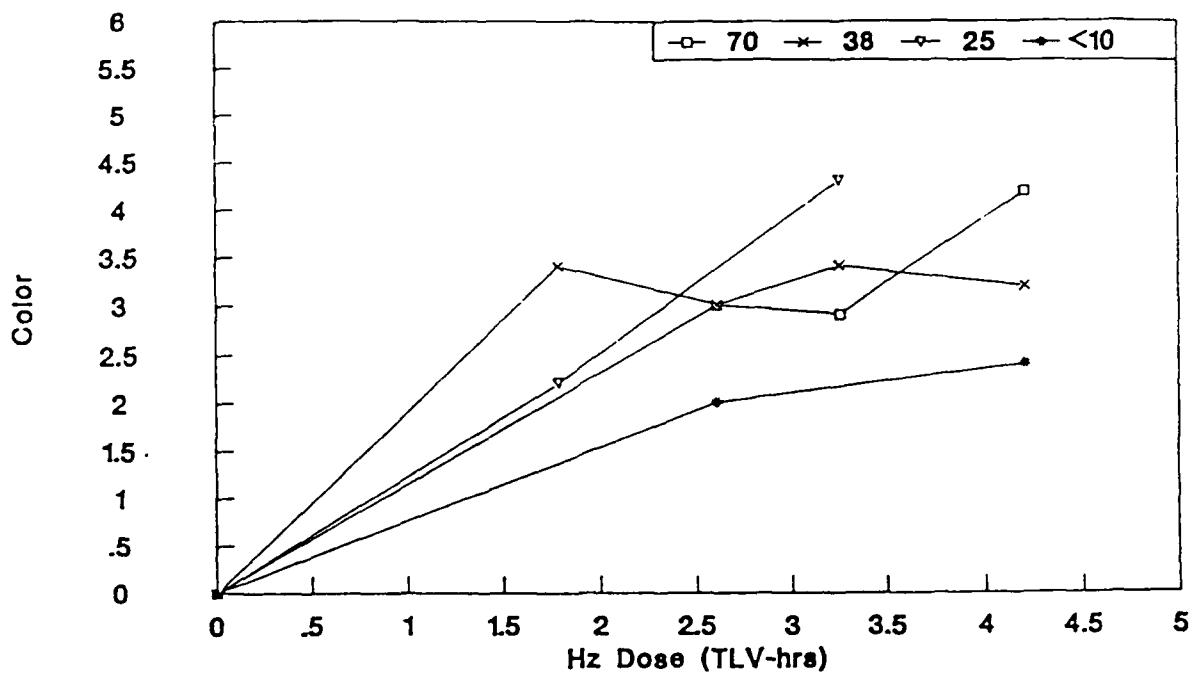


Fig. 14a. Hydrazine Humidity Response at T=0 for PDAB (D12, D12+D14)

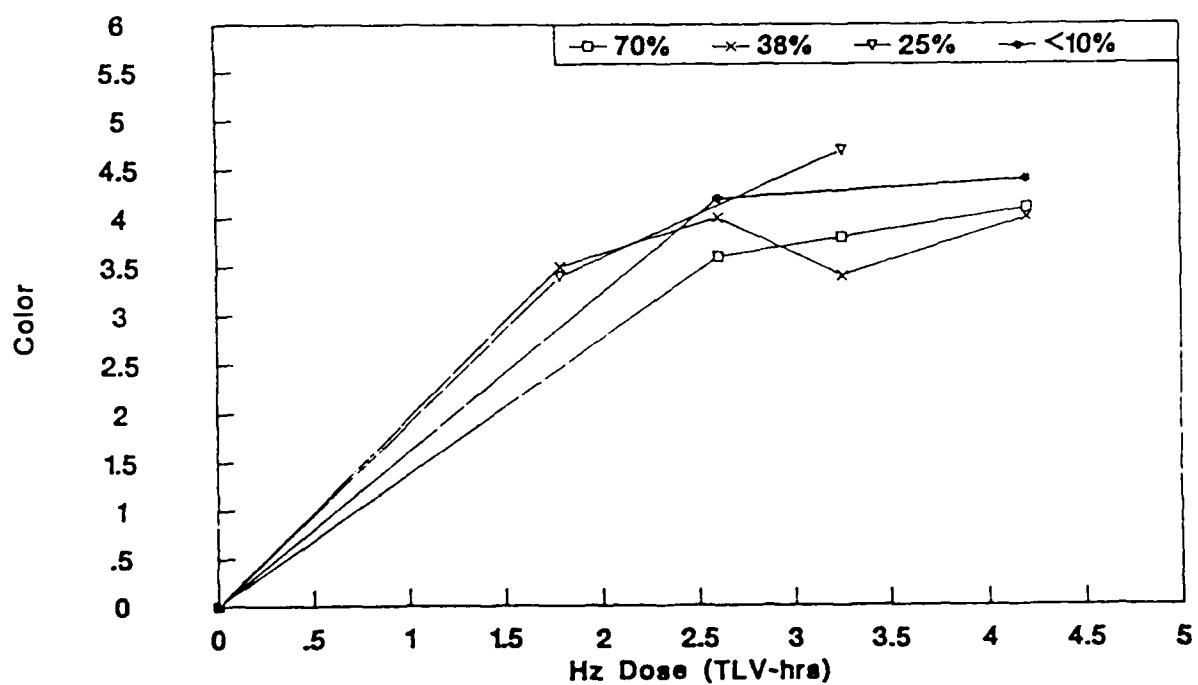


Fig. 14b. Hydrazine Humidity Response at T=1 for PDAB (D12, D12+D14)

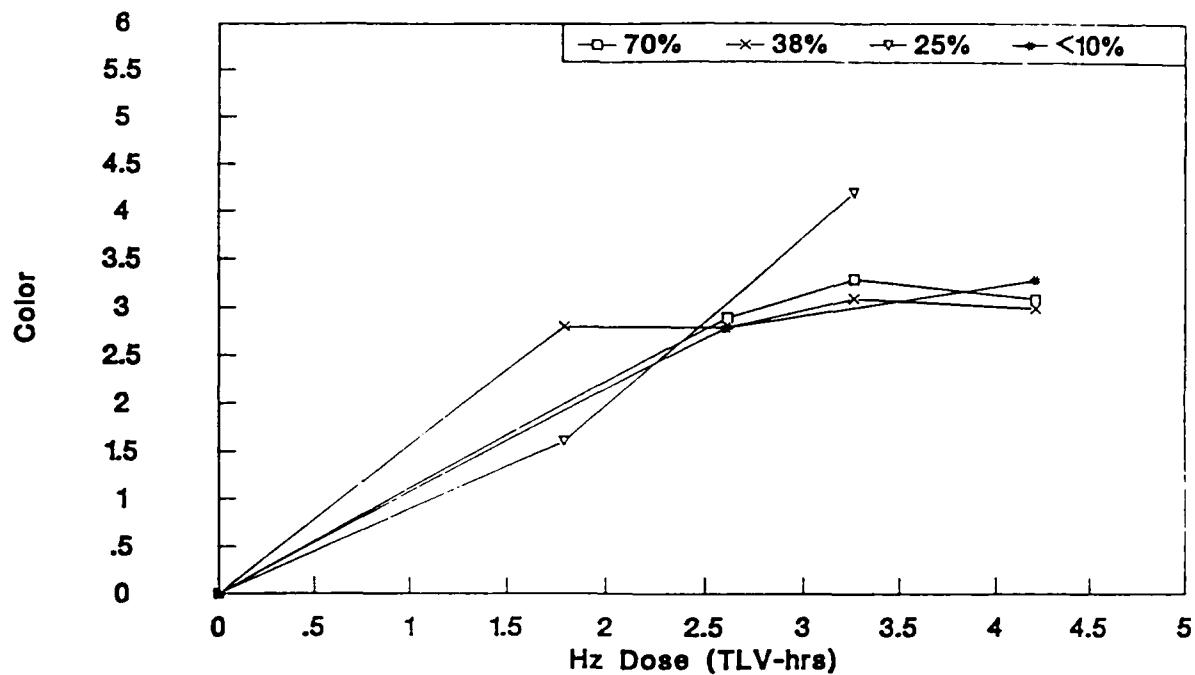


Fig. 14c. Hydrazine Humidity Response at T=0 for Vanillin (D14, D12+D14)

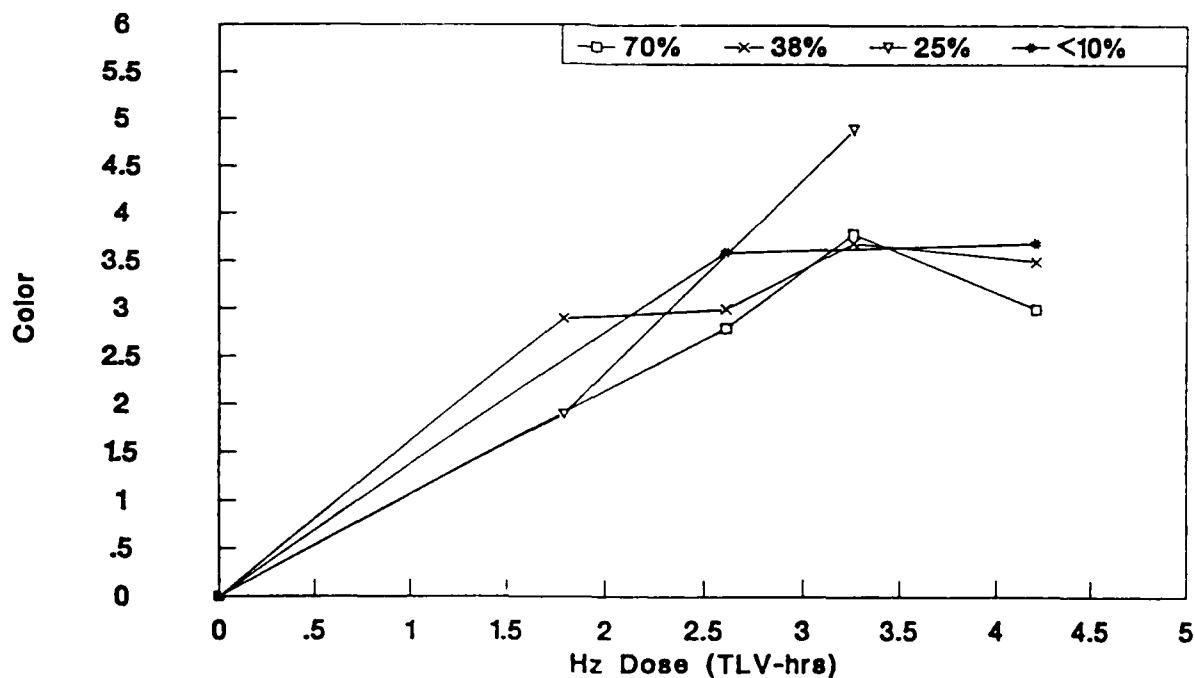


Fig. 14d. Hydrazine Humidity Response at T=1 for Vanillin (D14, D12+D14)

Table 6. Interferent Response of Badges

Badge Type	Interferent	MMH Dose (TLV-hrs)	Post MMH	Color Post Interferent
PDAB VAN	Heat	2.1	2.8	4.0
	Heat		3.2	4.0
PDAB VAN	Heat		1.7	3.0
	Heat		2.4	2.7
PDAB VAN	Heat		2.0	2.8
	Heat		2.0	2.8
PDAB VAN	Cold		3.0	3.2
	Cold		2.3	3.2
PDAB VAN	Cold		2.2	2.8
	Cold		3.0	3.0
PDAB VAN	Cold		2.0	2.5
	Cold		2.0	2.0
PDAB VAN	Sun		3.0	3.7
	Sun		3.0	3.5
PDAB VAN	Sun		2.5	2.7
	Sun		3.2	3.5
PDAB VAN	Sun		3.2	3.5
	Sun		2.5	2.8
PDAB VAN	UV-254		2.3	2.8
	UV-254		2.3	2.3
PDAB VAN	UV-254		2.8	3.3
	UV-254		3.0	3.0
PDAB VAN	UV-350		1.8	2.0
	UV-350		2.0	2.0

Table 7. Interferent Response for Badges

Badge Type	Interferent	MMH Dose (TLV-hrs)	Post Interferent	Color	Post MMH
PDAB VAN	Heat	2.1	0.5	2.3	
	Heat		0.5	2.8	
PDAB VAN	Heat		0.5	2.2	
	Heat		0.5	2.3	
PDAB VAN	Heat		0.5	2.3	
	Heat		0.5	2.0	
PDAB VAN	Cold		0.5	2.0	
	Cold		0.5	2.0	
PDAB VAN	Cold		0.5	3.0	
	Cold		0.5	3.8	
PDAB VAN	Cold		0.5	2.2	
	Cold		0.5	3.0	
PDAB VAN	UV-254		0.5	3.3	
	UV-254		0.5	3.1	
PDAB VAN	UV-350		0.5	3.3	
	UV-350		0.5	3.3	
PDAB VAN	UV-350		0.5	3.0	
	UV-350		0.5	3.2	

exposure to 2.1 TLV-hours of MMH for both PDAB and vanillin.

There was no significant change in color intensity from exposure to sunlight after MMH exposure. The average color for the PDAB badges after exposure to MMH was similar to the normal color intensity for 2.1 TLV-hours. The color of the vanillin was less intense than normal.

Exposure to a UV lamp source caused no significant change in color for either badge chemistries. When exposed to UV light initially, the badges developed a minimal color as they had with the heat and cold interferences. Exposure to UV light did not hinder subsequent color development in the presence of MMH. After exposure to MMH, both the PDAB and vanillin developed color of 3.2 intensity. This was normal color intensity for PDAB; slightly lower than normal for vanillin.

Several badges were exposed to sunlight alone during late summer (Table 8). They were tested in both horizontal and vertical positions for periods ranging from 0.25 to 2 hours. The vanillin badges showed no color development in either position. The PBAB badges developed 0.5 color within 0.25 hours and 1-2 color by 2 hours. These badges were evaluated on the vanillin color wheel as they developed a yellow color on exposure to sunlight.

Table 8. Sunlight Interferent Response

Badge Type	Badge Position	Exposure Time (hrs)				
		0.25	0.5	0.75	1.0	2.0
PDAB	Horiz	0.5	1.0	1.5	1.5	1.5
Van		0.0	0.0	0.0	0.0	0.0
PDAB	Vert	0.5	1.5	1.5	1.5	2.0
Van		0.0	0.0	0.0	0.0	0.0
PDAB	Horiz	0.5	0.5	0.5	0.5	1.0
Van		0.0	0.0	0.0	0.0	0.0
PDAB	Vert	0.5	0.5	0.5	0.5	1.0
Van		0.0	0.0	0.0	0.0	0.0

Interferent tests with NO_2 , NH_3 , and freons were accomplished at NRL. The dosimeters were exposed to the interferents both before and after MMH. Exposure times for both the MMH and the interferents were one hour. Table 9a shows the data for NO_2 exposure after MMH exposure. NO_2 did not affect the badges after exposure to MMH. When exposed to NO_2 prior to MMH, the badges developed minimal color (0.5) after first exposure to the interferent as shown in Table 9b. NO_2 did not retard color development for subsequent exposure to MMH.

The PDAB badges were affected by exposure to NH_3 after MMH (Tables 10a and 10b). The color intensity of the badges increased after they were exposed to the interferent. The vanillin badges did not show a significant color change due to the interferent. As shown in Table 10b, both PDAB and vanillin showed a minimal increase in color of 0.5 when first exposed to NH_3 . Table 11a and 11b give freon exposure information. The PDAB showed a slight increase in color when exposed to MMH and then freons. The vanillin was not affected by exposure to freons before or after exposure to MMH.

A color change was observed on a few of the field tested badges. In most cases the color was very pale and in some cases the color was different than expected. Only one exposure was independently measured using the citric acid badge. This exposure occurred in the Witech Lab. Three citric acid badges showed a small hydrazine exposure. The vanillin proportion of the badge turned yellow on four of ten badges. Three of the badges corresponded to the positive exposures on the citric acid badges. The PDAB proportion of the badge showed an orange response in nine of the ten badges. These unverified responses have not been explained.

The PDAB portion of the badges that were field tested outside showed color development; this could indicate a sunlight interference. The PDAB spot turned yellow in several of the tests. In a few of the tests, badges outside did not develop color and badges inside turned pale yellow. The vanillin badge did not change color in the sun. The inconsistencies cannot be explained.

All of the vanillin badges in the break room (lounge) turned pale pink. The air in the break room contained much cigarette smoke. To evaluate cigarette smoke as an interferent, a badge was exposed to cigarette smoke in a jar. It also turned pink.

CONCLUSIONS

The dosimeters show a large amount of scatter in color development at low doses. Some of this scatter can be attributed to experimental procedure. The PDAB badges (D12) show the greatest amount of scatter. The use of a membrane does not significantly affect the performance of the badges. Color development shows a time dependence for all badge types tested. Therefore, the immediate color development of the badges should be viewed as a warning sign, while the later development of the color on the badges after removal from a contaminated area may be more accurate.

Table 9a. Post-MMH NO₂ Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Color	
			Post MMH	Post Interferent
PDAB VAN	5.0	0.89	2.0 2.3	2.0 2.3
PDAB VAN	5.0	0.89	1.0 2.0	1.0 2.0
PDAB VAN	5.0	0.89	1.5 3.0	2.0 3.0
Control	0.0	0.89	1.0 2.0	1.5 2.0

Table 9b. Pre-MMH NO₂ Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Color	
			Post Interferent	Post MMH
PDAB VAN	5.0	0.89	0.5 0.5	1.3 2.5
PDAB VAN	5.0	0.89	0.5 0.5	1.3 2.3
PDAB VAN	5.0	0.89	0.5 0.5	1.3 2.5
Control	5.0	0.00	0.5 0.5	0.5 0.5

Table 10a. Post-MMH NH₃ Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Post MMH	Color Post Interferent
PDAB VAN	20.4	0.82	1.5 3.0	3.0 3.3
PDAB VAN	20.4	0.82	1.3 2.0	2.0 2.0
PDAB VAN	20.4	0.82	2.0 2.5	3.0 3.3
Control	0.0	0.82	1.5 2.0	2.0 2.0

Table 10b. Pre-MMH NH₃ Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Post Interferent	Color Post MMH
PDAB VAN	20.4	0.82	0.5 0.5	3.0 3.0
PDAB VAN	20.4	0.82	0.5 0.5	2.8 2.8
PDAB VAN	20.4	0.82	0.5 0.5	2.8 2.5
Control	20.4	0.00	0.5 0.5	0.8 0.5

Table IIa. Post-MMH Freon Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Color	
			Post MMH	Post Interferent
PDAB VAN	29.4	0.99	1.0	1.8
			2.0	2.0
PDAB VAN	29.4	0.99	1.8	2.3
			3.0	3.0
PDAB VAN	29.4	0.99	1.8	2.3
			2.8	3.0
Control	0.0	0.99	1.5	2.0
			2.0	2.0

Table IIb. Pre-MMH Freon Interferent Response

Badge Type	Interferent Conc. (ppm)	MMH Dose (TLV-hrs)	Color	
			Post Interferent	Post MMH
PDAB VAN	29.4	0.99	0.0	2.0
			0.0	2.5
PDAB VAN	29.4	0.99	0.0	1.8
			0.0	2.0
PDAB VAN	29.4	0.99	0.0	1.8
			0.0	2.0
Control	29.4	0.00	0.0	0.0
			0.0	0.0

The composite badges (D13+D12) show an increased sensitivity and stability when compared to badges where the chemistries are used individually (D13, D12). The incorporation of two different chemistries on one badge may allow each to influence the performance of the other due to sublimation of the materials. Doses required to produce mid-range colors; that is, a color of 5 on the old wheel and a color of 3 on the new wheel, have been summarized in Table 12.

Relative humidity does not significantly affect the color development on any badge chemistry. The interferent tests indicate that heat is an interferent when badges are exposed to MMH first. Sunlight affects color development in the PDAB badges. The badges developed a yellow color that had to be evaluated with the vanillin color wheel. The PDAB badges were also affected by exposure to NH₃ after exposure to MMH. The vanillin badges were not significantly affected by the interferents tested. It was noted that vanillin is affected by tobacco smoke. A pink-purple color develops.

The yellow color development of the PDAB and the pink color response of the vanillin was observed in the field tests. The yellow responses of PDAB were not always consistent with the sunlight exposure. The expected color responses of orange for PDAB and yellow for vanillin were only observed in one location of the field test. The vanillin produced four positive results and all but one were independently verified. The PDAB badges produced six apparently false positive responses.

Table 12. Summary of Doses Required for Mid-Range Color

Badge Type	Gas	Diffusion Membrane	Dose (TLV-hrs)	
			T=0	T=1
PDAB (D12)	MMH	no	4.5	3.0
		yes	5.0	3.0
Vanillin (D13)	MMH	no	6.0	4.0
		yes	4.0	2.5
Vanillin (D14)	MMH	no	4.0	4.0
		yes	2.0	2.0
Vanillin (D13) (D13+D12)	Hz	no	7.0	5.0
		no	2.5	2.0
PDAB (D12) (D13+D12)	MMH	no	4.0	4.0
		no	2.0	2.0
PDAB (D12) (D12+D14)	MMH	no	1.25	1.0
		no	2.0	1.0
Vanillin (D14) (D12+D14)	MMH	no	2.0	1.5
		no	1.0	0.9

REFERENCES

1. Hannum, J.A.E., "Recent Developments in the Toxicology of Propellant Hydrazines", Chemical Propulsion Information Agency, CPTR 82-15, June 1982.
2. Hawkins, C.M., S.L. Rose, J.R. Wyatt, "A Passive Dosimetry Method for Determining Hydrazines in Air", CPIA 436, Proceedings of the 1985 JANNAF Safety and environmental Protection Subcommittee Meeting, (Monterey, CA, 4-8 November 1985) Naval Postgraduate School, November 1985.
3. Taffe, P.A., S.L. Rose, "Hydrazine Detection", U.S. Patent #4,900,681, issued 13 February 1990
4. Snow, A., S. Rose, Review of Specific Chemical Interactions for Hydrazine Analysis and Proposed Adaptation for Microsensor Chemical Detection, NRL Memorandum Report 546 1, Naval Research Laboratory, Washington, DC, 30 November 1984.
5. Taffe, P.A., J.R. Wyatt, "Real-Time Passive Dosimeter for HCL Vapor", Proceedings of the 1989 JANNAF Safety and Environmental protection Subcommittee Meeting, (Brooks Air Force Base, San Antonio, TX, 3-6 April, 1989).
6. Rose, S.L., J.R. Holtzclaw, A Critical Comparison of Commercially Available Hydrazine Detectors, NRL Report 8848, Naval Research Laboratory, Washington, D.C., March 19, 1985.
7. Taffe, P.A., Brown, S.W., Thurow, A.R., Travis, J.C., Rose-Pehrsson, S.L., and Wyatt, J.R., "Field Evaluation of a Passive Sampling Device for Hydrazines in Ambient Air", NRL Memorandum Report 6613 (1990).
8. Olson, E.C., "The Coulometric Determination of Hydrazine and Substituted Hydrazine", Analytical Chemistry, 32 (12), 1960, pp.1545-1547.
9. NIOSH Manual of Analytical Methods, 2nd ed., DHEW (NIOSH), Cincinnati, OH, 1977, Vol 3, Publication 77-157c.

APPENDIX A
NRL Data Sheets

GMD COLOR BADGE LOG SHEET

TEST 1

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
83477	D12	1/24	.107	none	4	2.14	40	25	2.0 5	2.0 5	2.5 7	2.2 5.7	2.0 4.5	2.0 5.5	2.0 6	2.0 5.3
84753	D13								2 3	3 4	3 3	2.7 3.3	2 3	2 3	3 2.5	2.3 2.8
83449	D13								3 3	4 4	3.5 3.5	3.5 3.5	3 3.5	3 4	3 4	3.0 3.8
59397	D14								2 4	3 4	3 5	2.7 4.3	2 4	2.5 4	2 3	2.2 3.7

GMD COLOR BADGE LOG SHEET

TEST 2

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
84304	D12	1/24	.084	none	16	6.72	40	25	8 8.5	8 9	8 9	8.0 8.8	7.5 8	8.5 8.5	8.0 9	8.0 8.5
82962	D13								6 8	6 7	5 8	5.7 7.7	6.5 8	5 8	6 8	5.8 8.0
85557	D13								8 8	9 9	9 9	8.7 8.7	7 8	6 9	7 8	6.7 8.3
59549	D14								7 9	6.5 9	7 9	6.8 9.0	7 9	8 9	7 9	7.3 9.0

GMD COLOR BADGE LOG SHEET

TEST 3

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
82408	D12	1/24	.06	none	.25	.075	40	25	0 0	0 0	0 0	.0 .0	.0 .5	.0 .5	.0 .5	.0 .5
84778	D13								0 .5	0 .5	0 .5	.0 .5	0 .5	0 .5	0 .5	.0 .5
83486	D13								0 0	0 0	0 0	.0 .0	.5 .5	.5 .5	.5 .5	.5 .5
59630	D14								0 .5	0 .5	0 0	.0 .3	0 .5	0 1	0 .5	.0 .7

GMD COLOR BADGE LOG SHEET

TEST 4

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
83467	D12	1/24	.06	none	.42	.126	99	25	0	0	0	.0	.0	.0
	D12								.5	.5	.5	.5	.5	.5
83919	D13								0	0	0	.0	0	0
	D13								.5	.5	.5	.5	.5	.5
81192	D13								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
59632	D14								.5	.5	.5	.5	.5	.3
	D14								1	1	1	1.0	1	1

GMD COLOR BADGE LOG SHEET

TEST 5

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84232	D12	1/24	.06	none	1	.3	40	25	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
84779	D13								.5	.5	.5	.5	.5	.5
	D13								1	1	1	1.0	1	1
81209	D13								1	1	1	1.0	1	1
	D12								.5	.5	.5	.5	.5	.5
59520	D14								0	0	0	.0	0	.5
	D14								1	1	1	1.0	1	1

GMD COLOR BADGE LOG SHEET

TEST 6

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84321	D12	1/25	.06	none	.42	.126	40	25	0	0	0	.0	.0	.0
	D12								0	0	0	.0	.5	.5
83909	D13								0	0	0	.0	0	0
	D13								.5	.5	.5	.5	.5	.5
85528	D13								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
59629	D14								0	0	0	.0	0	0
	D14								.5	.5	.5	.5	.5	.5

GMD COLOR BADGE LOG SHEET

TEST 7

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
83522	D12	1/24	.089	none	16	7.12	40	25	8	8.5	8.5	8.3	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	
	D12								8	8.5	8.5	8.3	7.5	8.5	7.5	7.5	7.8						
84774	D13								8	8	6	7.3	8	8	7	7.7							
	D13								8	8	7	7.7	8	8	8	8.0							
	D13								9	9	8.5	8.8	8.5	9	8.5	8.7							
59371	D12								9	9	8.5	8.8	8.5	9	8.5	8.7							
	D14								9.5	9.5	9	9.3	9.5	9.5	9	9.3							
GMD COLOR BADGE LOG SHEET								TEST 8															

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
84322	D12	1/24	.08	none	4	1.6	40	25	2.5	2.5	3	2.7	2.5	2.5	4.5	3.2							
	D12								4.5	5.5	5	5.0	4.5	5.5	5	5.0							
84745	D13								3	3	4	3.3	3	3	4	3.3							
	D13								4.5	4.5	5.5	4.8	5	4.5	5	4.8							
	D13								3.5	4	4	3.8	4	4	4	4.0							
85543	D12								4	4.5	5	4.5	4.5	5.5	4.5	4.8							
	D14								3	3	3	3.0	3	3	3	3.0							
59542	D14								5	5	5	5.0	5	5	5	5.0							
	D14																						
GMD COLOR BADGE LOG SHEET								TEST 9															

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1												
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver		
83532	D12	1/24	.08	none	2	.8	40	25	.5	.5	.5	.5	.5	.5	.5									
	D12																							
84831	D13								1.5	1.5	1.5	1.5	2	2	2.0									
	D13																							
	D12								1.5	2.5	2.3	2.3	1.5	2.5	2.0									
81272	D13								2	2.5	2.3	2.3	2	2.5	2.0									
	D12																							
59384	D14								2	1.5	1.8	1.8	4	4.5	4.3									
	D14																							
GMD COLOR BADGE LOG SHEET								TEST 9																

GMD COLOR BADGE LOG SHEET

TEST 10

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
84287	D12	1/24	.08	none	16	6.4	40	25	7.5 9	7.5 9	7.0 8.7	7.5 8.5	8.5 9	9.0 9.8	
	D12														
84766	D13								5 5	5 5	6.3 6.3	5 5	5 5.5	4 5	4.7 5.2
	D13														
83515	D13								6 8	6 8.5	6.0 8.5	5.5 8	5 8.5	5 8	5.2 8.2
	D12														
59362	D14								9 9.5	9 9.5	9.0 9.5	9 9.5	9 9.5	9 9	9.0 9.3
	D14														

GMD COLOR BADGE LOG SHEET

TEST 11

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
80000	D12	1/24	.08	none	4	1.6	40	25	2.5 2	3.5 3.5	2.7 3.2	3.5 3.5	4.0 4	4.5 4.5	4.0 4.0
	D12														
83839	D13								3.5 4	4 4.5	2.8 5.2	3.5 4	4 4.5	4 4.5	3.8 4.3
	D13														
81260	D13								2.5 2.5	3 4	2.8 5.2	2.5 3	2 4	2 4.5	2.2 3.8
	D12														
59581	D14								1 6	8 8	3.3 7.0	1 7	1 7	1 8	1.0 7.3
	D14														

GMD COLOR BADGE LOG SHEET

TEST 12

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
83479	D12	1/24	.097	none	2.25	1.09125	70	25	.5 2.5	.5 3.5	5.5 4	2.2 3.3	.5 2.5	1.0 3.5	1.5 1.5	1.0 2.5
	D12															
83927	D13								1 2	1 2	2 3.5	1.3 2.5	1 2	1 2	1 2.5	1.0 2.2
	D13															
85507	D13								4.5 3.5	5 3.5	5.5 4	5.0 3.7	5 3.5	5 4.5	5.5 4.5	5.2 4.2
	D12															
59372	D14								1.5 2.5	1.5 3	2 3.5	1.7 3.0	2 3	1.5 3	2 3	1.8 3.0
	D14															

GMD COLOR BADGE LOG SHEET

TEST 13

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
83481	D12	1/24 .096	none	.25	.12	70	25	0	0	0	.0	.0	.0
	D12							.5	.5	0	.3	.5	.5
83921	D13							0	0	0	.0	0	0
	D13							.5	.5	.5	.5	.5	.5
81253	D13							.5	.5	.5	.5	1	1
	D12							0	0	0	.0	.5	.5
59577	D14							0	0	0	.0	0	0
	D14							.5	.5	.5	.5	.5	.7

GMD COLOR BADGE LOG SHEET

TEST 14

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
83449	D12	1/24 .096	none	.25	.12	70	25	0	0	0	.0	.0	.2
	D12							.5	.5	0	.3	.5	.5
84883	D13							0	0	0	.0	0	0
	D13							.5	.5	.5	.5	.5	.5
81208	D13							.5	.5	.5	.5	.5	.5
	D12							.5	.5	0	.3	.5	.5
59459	D14							0	0	0	.0	.5	.3
	D14							.5	.5	.5	.5	.5	.7

TEST 15

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
D12	1/24 .096	none	.25	.12	70	25	0	0	0	.0	.0	.5	.2
	D12							.5	.5	.5	.5	.5	.5
D13							0	.5	0	.2	.5	.5	.3
	D13						.5	.5	3	1.3	.5	.5	.5
D13							.5	.5	0	.3	.5	.5	.5
D12							0	.5	0	.2	.5	.5	.5
D14							.5	0	0	.2	0	0	0
	D14						.5	.5	1	.7	.5	.5	.5

TEST 16

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
83500	D12	1/24	.075	none	2.66	1.00	70	25	.5 1.5	.5 1.5	1 3	.7 2.0	.5 2	.5 2	1.0 3	.7 2.3
84818	D13								2.5 4.5	2 4.5	3 5	2.5 4.7	3 4.5	2.5 4.5	3 4	2.8 4.3
85524	D13								4.5 2	4.5 3	6 4	5.0 3.0	4 2.5	4.5 4	5 4	4.5 3.5
59480	D14								1.5 4	1.5 4	2 4	1.7 4.0	2 4	1.5 4	1.5 4	1.7 4.0

TEST 17

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
83487	D12	1/24	.077	none	2	.77	70	25	.5 1.5	.5 2	1 2.5	.7 2.0	1.0 2	1.0 2	1.0 2.2
84833	D13								2 3	2 4	2 4	2.0 3.7	2 3	2 4	2 3.3
83487	D13								3 1.5	3 2	3 3	3.0 2.2	3 3	3 3	3 2.7
59608	D14								1 2.5	.5 2	1 3.5	.8 2.7	1 3	2 3	1 3.0

TEST 18

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
82379	D12	2/1	.092	none	8	3.68	40	25	6 8	6 9	6 8	6.0 8.3	8.0 9	7.5 9	7.8 9.0
83906	D13								8 7	8 7	7 7.5	7.7 7.2	9 8	8.5 8	8.8 8.0
85559	D13								7 6	8 7	7 7	7.3 6.7	9 8	8 8	8.5 8.0
59369	D14								8 9	9 9.5	8 9	8.3 9.2	9 9	8.5 9	8.8 9.0

TEST 19

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
84283	D12	2/1	.122	none	8	4.88	40	25	8	8	8.5	8.2	8.0	8.5	8.3
	D12								8	8	8.5	8.2	8	8.5	8.3
82981	D13								7	8	6	7.0	8	7	7.5
	D13								8	8	7	7.7	8	7	7.5
81201	D13								8	8	8	8.0	8	7	7.5
	D12								9	9	9	9.0	9	9	9.0
59555	D14								8.5	9	8	8.5	9	8	8.5
	D14								7.5	8	8	7.8	8	7	7.5

TEST 20

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
83517	D12	2/9	.13	none	6.2	4.03	40	25	6	6.5	7	6.5	6.0	5.5	7.0	6.2
	D12								5.5	6.5	7	6.3	6	5.5	7.5	6.3
84747	D13								5.5	5.5	5	5.3	5.5	5	5	5.2
	D13								6	6	6	6.0	6	6	6	6.0
85584	D13								5	5	6	5.3	5	5	5	5.0
	D12								5	5.5	6	5.5	5.5	5	7	5.8
59546	D14								5	5.5	7	5.8	6	5	5	5.3
	D14								8	8	8	8.0	7.5	8	8	7.8

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TEST 21

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
84251	D12	2/13	.212	none	4	4.24	40	25	4.5	4.5	4.0	4.3	4.5	4.5	5.0	4.7
	D12								4.5	4	4	4.2	4.5	4.5	5	4.7
84804	D13								4	4	2	3.3	4	3.5	3	3.5
	D13								4	4	2	3.3	4	4	3	3.6
81264	D13								4.5	4.5	4	4.3	4.5	4.5	5	4.7
	D12								4.5	5.5	5	5.0	5	5.5	5	5.2
59444	D14								4	4	3	3.7	4	4	3	3.6
	D14								4.5	4.5	3	4.0	4	4.5	3	3.8

GMD COLOR BADGE LOG SHEET

TEST 22

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0				T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver
82330	D12	2/13	.2	none	.25	.25	40	25	0	0	0	0	.0			.5	.5	.5	.5	.5	.5	.5	.5	
	D12								0	0	0	0	.0			.5	.5	.5	.5	.5	.5	.5	.5	
84777	D13															.5	0	0	.2	.5	.5	.5	.5	.5
	D13															.5	.5	.5	.5	1	1	1	1	1.0
85567	D13															.5	.5	.5	.5	1	.5	1	.8	
	D12															0	.5	0	.2	.5	.5	.5	1	.7
59481	D14															.5	0	0	.2	.5	.5	.5	.5	.5
	D14															.5	.5	.5	.5	.5	.5	1	.7	

GMD COLOR BADGE LOG SHEET

TEST 23

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0				T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver
82423	D12	2/13	.2	none	.25	.25	40	25	0	0	0	0	.0			.0	.0	.0	.0	.0	.0	.0	.0	
	D12								.5	.5	0	0	.3			.5	.5	.5	.5	.5	.5	.5	.5	
82914	D13										0	0	0	.0			0	0	0	0	0	0	0	.0
	D13										.5	.5	1	.7			.5	.5	1	.7				
83513	D13										.5	.5	1	.7			1	1	1	1.0				
	D12										.5	.5	.5	.5			.5	.5	1	.7				
59571	D14										.5	.5	.5	.5			.5	.5	.5	.5	.5	.5	.5	.5
	D14										.5	.5	1	.7			.5	.5	1	.7				

GMD COLOR BADGE LOG SHEET

TEST 24

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0				T=1												
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver	
82395	D12	2/13	.2	none	16	16	40	25	9	9	9	9	9.0			9.0	9.5	9.0	9.2						
	D12								9	9	9	9	9.0			9	9	9	9.0						
82971	D13										9	9	9	9	9.0			9	9.5	9	9.2				
	D13										9	9	9	9	9.0			9	9.5	9	9.2				
83469	D13										9	9	9	9	9.0			9.5	9.5	9	9.3				
	D12										9	9.5	9	9.2			9.5	9	9	9.2					
59621	D14										9.5	9	9	9.2			9.5	9.5	9.5	9.5					
	D14										9.5	9	9	9.2			9.5	9.5	9.5	9.5					

GMD COLOR BADGE LOG SHEET

TEST 22

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
82330	D12	2/13	.2	none	.25	.25	40	25	0	0	0	.0	.5	.5	.5	.5
	D12								0	0	0	.0	.5	.5	.5	.5
84777	D13								.5	0	0	.2	.5	.5	.5	.5
	D13								.5	.5	.5	.5	1	1	1	1.0
85567	D13								.5	.5	.5	.5	1	.5	1	.8
	D12								0	.5	0	.2	.5	.5	1	.7
59481	D14								.5	0	0	.2	.5	.5	.5	.5
	D14								.5	.5	.5	.5	.5	.5	1	.7

GMD COLOR BADGE LOG SHEET

TEST 23

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3 Aver	1	2	3 Aver	
82423	D12	2/13	.2	none	.25	.25	40	25	0	0	0	.0	.0	.0	.0
	D12								.5	.5	0	.3	.5	.5	.5
82914	D13								0	0	0	.0	0	0	0
	D13								.5	.5	1	.7	.5	.5	1
83513	D13								.5	.5	1	.7	1	1	1
	D12								.5	.5	.5	.5	.5	.5	.7
59571	D14								.5	.5	.5	.5	.5	.5	.5
	D14								.5	.5	1	.7	.5	.5	1

GMD COLOR BADGE LOG SHEET

TEST 24

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
82395	D12	2/13	.2	none	16	16	40	25	9	9	9	9.0	9.0	9.5	9.0	9.2
	D12								9	9	9	9.0	9	9	9	9.0
82971	D13								9	9	9	9.0	9	9.5	9	9.2
	D13								9	9	9	9.0	9	9.5	9	9.2
83469	D13								9	9	9	9.0	9.5	9.5	9	9.3
	D12								9	9.5	9	9.2	9.5	9	9	9.2
59621	D14								9.5	9	9	9.2	9.5	9.5	9.5	9.5
	D14								9.5	9	9	9.2	9.5	9.5	9.5	9.5

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TEST 25

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
84281	D12	2/14	.2	none	.25	.25	40	25	0	0	.5	.2	.0	.0	.5	.2
	D12								.5	.5	.5	.5	.5	.5	1	.7
82964	D13								.5	.5	.5	.5	.5	.5	.5	.5
	D13								.5	.5	1	.7	1	1	1	1.0
81207	D13								.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5	.5	.5
59400	D14								.5	.5	.5	.5	.5	.5	1	.7
	D14								1	1	1	1.0	1	1	1	1.0

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TEST 26

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
82336	D12	2/14	.2	none	4	4	40	25	6	7.5	7	6.8	7.5	7.5	7.5	7.5
	D12								7	8	7.5	7.5	8	7.5	8	7.8
84809	D13								4.5	5	5	4.8	5	5.5	5.5	5.3
	D13								4.5	5	5	4.8	5	5.5	5.5	5.3
83493	D13								6	6	7	6.3	7.5	7	8	7.5
	D12								7	8	8	7.7	7.5	7.5	8.5	7.8
59591	D14								7	8	7	7.3	8	7	6.5	7.2
	D14								8	8.5	8	8.2	8.5	8	7	7.8

GMD COLOR BADGE LOG SHEET

TEST 27

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
82342	D12	2/14	.2	none	16	16	40	25	9.5	9.5	9	9.3	9.5	9.5	9.0	9.3
	D12								9.5	9.5	9	9.3	9.5	9.5	9	9.3
82986	D13								8	9	8	8.3	8.5	9	8.5	8.7
	D13								9	9	8.5	8.8	9	9	9	9.0
85590	D13								9	9.5	9	9.2	9.5	9	9	9.2
	D12								9	9.5	9	9.2	9.5	9	9	9.2
59389	D14								9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
	D14								9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5

GMD COLOR BADGE LOG SHEET

TEST 28

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
82357	D12	.133	.2	none	2	2	40	25	2	3.5	5	3.5			4.5	5.0	5.0	5.0	4.8				
	D12								4.5	4.5	5	4.7					5	5.5	5	5.2			
83881	D13								3.5	4.5	3	3.7					4	4.5	3	3.8			
	D13								3.5	4	4	3.8					4	4	4	4.0			
85598	D13								5	5	5	5.0					5	5	5	5.0			
	D12								3	4.5	5	4.2					4.5	4.5	5	4.7			
59449	D14								3	3	2	2.7					3.5	3	3	3.2			
	D14								4	4.5	3	3.8					4	4.5	3	3.8			

GMD COLOR BADGE LOG SHEET

TEST 29

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
84309	D12	2/15	.2	none	2	2	40	25	3.5	4	4	3.8			4.5	5.0	4.5	4.7					
	D12								3	3.5	3	3.2					4	4.5	4.5	4.3			
83884	D13								3	3	4	3.3					3	3	3	3.0			
	D13								4.5	4	4	4.2					4.5	4.5	4.5	4.5			
81210	D13								4.5	4.5	4	4.3					4.5	4.5	4	4.3			
	D12								3	3.5	4	3.5					4	4.5	4.5	4.3			
59456	D14								5	5	5	5.0					5	5.5	5	5.2			
	D14								5.5	6	5	5.5					6	6	6	6.0			

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TEST 30

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
82392	D12	2/15	.2	none	16	16	40	25	9.5	9.5	9.5	9.5			9.5	9.5	9.0	9.3					
	D12								9	9	9.5	9.2					9	9	9	9.0			
82906	D13								9	9.5	9	9.2					9	9	9	9.0			
	D13								9	9	9	9.0					9	9	9	9.0			
85562	D13								9	9	9	9.0					9	9.5	9	9.2			
	D12								9	9	9	9.0					9	9.5	9	9.2			
59356	D14								9.5	9.5	9	9.3					9.5	9.5	9	9.3			
	D14								9.5	9.5	9	9.3					9.5	9.5	9	9.3			

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TEST 31

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
84244	D12	2/16	.2	none	4	4	40	25	5	5	5	5.0	5.5	6.0	7.0	6.2	6	6.5	6.3	6	7	8	7.0
	D12																						
83871	D13								5	5.5	5	5.3	5	5.5	6	5.5	6.5	6	6.3	7	7	7	7.0
	D13																						
83506	D13								6.5	6	6.3	6.3	6	6	6	6.0	6.5	6.5	6.5	7	6.7	6.7	6.0
	D12								6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.7							
59649	D14								5	4.5	4.8	4.8	5	5.5	4	4.8	7	7	7.0	7	7.5	7	6.2
	D14																						

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TEST 32

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
84277	D12	2/16	.2	none	.25	.25	70	25	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
	D12								.5	.5	0	.3	.5	.5	.5	.5	.5	.5	.5	1	.7	
82912	D13								0	0	.5	.2	0	0	0	0	0	0	0	0	0	0
	D13								1	.5	1	.8	1	1	1	1	1	1	1	1	1	1.0
81266	D13								.5	.5	1	.7	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	1	.7	
59531	D14								.5	.5	1	.7	.5	.5	.5	.5	.5	.5	.5	0	.3	
	D14								1	1	1	1.0	1	1	1	1	1	1	1	1	1	1.0

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TEST 33

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83438	D12	2/16	.2	none	.25	.25	70	25	0	.5	0	.2	.5	.0	.0	.5	.0	.0	.0	.0	.0	.2
	D12								.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
84815	D13								.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	0	.3	
	D13								1	1	1	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
81247	D13								.5	1	.5	.7	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	1	.5	.7	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
59626	D14								.5	.5	.5	.5	.5	.5	.5	.5	1	1	.5	1	1	1.0
	D14								1	1	1	1.0	1	1	1	1	1	1	1	1	1	1.0

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TEST 34

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1		
							1	2	3 Aver	1	2	3 Aver
83352	D12	2/16	.2	none	.25	.25	70	25	0 .5	0 .5	0 .5	.0
	D12									.5 .5	.0 .5	.0 .5
83845	D13								.5 .5	0 1	.5 .5	.3 .7
	D13										0 1	.5 .8
81218	D13								.5 .5	1 1	.5 .5	.7 .7
	D12											
59411	D14								.5 1	.5 1	.5 1	.5 1
	D14											.7 .8

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TEST 35

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1		
							1	2	3 Aver	1	2	3 Aver
84286	D12	2/17	.2	none	8	8	40	25	7.5 7.5	8.5 8	8.5 8.5	8.2 8.0
	D12										8 8	8.5 8.2
83004	D13								7 7	7 7	6 6	6.7 6.7
	D13										7 7	7 7.0
85603	D13								8 8	8 8.5	7 9	7.7 8.5
	D12											
59539	D14								8 9	9.5 9.5	8 9	8.5 9.2
	D14											9 9

GMD COLOR BADGE LOG SHEET

TEST 36

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1		
							1	2	3 Aver	1	2	3 Aver
84234	D12	2/22	.2	none	8	8	40	25	9 9	9 9	9 9	9.0 9.0
	D12											9.0 9.0
83923	D13								7 8	7.5 8	7 8	7.2 8.0
	D13											8 8
85595	D13								7 8.5	8 8.5	8.5 8.5	7.8 8.5
	D12											
59401	D14								9 9	9.5 9	9 9	9.2 9.0
	D14											9.0 9.0

GMD COLOR BADGE LOG SHEET

TEST 37

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
82409	D12	2/23	.2	none	8	8	40	25	8	8	8 8.0	8.0	8.5	8.5 8.3
									8	8.5	9 8.5	8.5	9	8.5 8.7
83848	D13								8	8	8 8.0	9	8	8.5 8.5
									8	8	8 8.0	8.5	9	8.5 8.7
83457	D13								8	8	8 8.0	8	8	8.5 8.2
									9	8.5	9 8.8	8	8	8.5 8.2
59651	D14								9	9.5	9 9.2	9.5	9	9 9.2
									9	9.5	9 9.2	9.5	9	9 9.2

GMD COLOR BADGE LOG SHEET

TEST 38

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84788	D12	2/24	.2	none	4	4	40	25	4.5	4.5	5.5 4.8	5.0	4.5	5.5 5.0
									5.5	6	6 5.8	5.5	6	6 5.8
82413	D13								5	5	5 5.0	4.5	4.5	5 4.7
									5.5	5	5 5.2	5	4.5	5 4.8
83463	D13								5	5	5 5.0	5	4.5	5 4.8
									5	6	5.5 5.5	5.5	5.5	5.5 5.5
59595	D14								6	7	7 6.7	6.5	6	7 6.5
									7	8	7.5 7.5	8	8	7.5 7.8

GMD COLOR BADGE LOG SHEET

TEST 39

I.D.	BADGE	DATE	MMH (ppm)	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84299	D12	2/28	.2	none	2	2	70	25	1	1	1 1.0	1.0	2.0	1.0 1.3
									4	4	4 4.0	3.5	4	4 3.8
84800	D13								2	2.5	3 2.5	2	2	3 2.3
									3.5	4.5	4 4.0	4	4	4 4.0
85510	D13								4	4.5	4 4.2	4	4	4 4.0
									2.5	3.5	3 3.0	2	3.5	3 2.8
59614	D14								4	4	3.5 3.8	4	4	3.5 3.8
									4.5	4.5	4 4.3	4.5	4.4	4.5 4.5

GMD COLOR BADGE LOG SHEET

TEST 40

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1									
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1
83434	D12	3/1	.2	none	2	2	70	25	1	1	.5	.8			.5	1.0	.5	.7			
	D12								3	3.5	4	3.5			3	4	4	3.7			
84800	D13								2	2.5	2.5	2.3			3	3	2	2.7			
	D13								3	4.5	5	4.2			5	5	5	5.0			
85510	D13								5	3	5	4.3			4.5	4.5	5	4.7			
	D12								3	4.5	4	3.8			2.5	4	3	3.2			
59614	D14								2	2	2	2.0			2	2	2	2.0			
	D14								3	4.5	4	3.8			4.5	4.5	5	4.7			

GMD COLOR BADGE LOG SHEET

TEST 41

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1									
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1
82410	D12	3/2	.2	none	2	2	70	25	1.0	1.0	1.0	1.0			1.0	1.5	1.0	1.2			
	D12								4	4	4	4.0			4	4.5	4	1.2			
83006	D13								4	4	3	3.7			3.5	3	4	3.5			
	D13								4.5	4.5	3	4.0			4	4.5	4	4.2			
81200	D13								4.5	4.5	4	4.3			4	4	4	4.0			
	D12								4.5	4.5	5	4.7			4.5	4.5	5	4.7			
59434	D14								4	4.5	4	4.2			4	4.5	4	4.2			
	D14								6	6	5.5	5.8			5.5	6	5.5	5.7			

GMD COLOR BADGE LOG SHEET

TEST 42

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1			
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)

Test invalid

GMD COLOR BADGE LOG SHEET

TEST 43

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1									
									#	TYPE	(ppm)	FERANT (hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83457	D12	4/19	.4	none	.25	.5	40	25	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
59501	D13								2	2	1	1.7			2	2	2	2.0			
	D13								1.5	1.5	2	1.7			1.5	1.5	1.5	1.5	1.5	1.5	1.5
59536	D13								2	2.5	2	2.2			2	2.5	3	2.5			
	D12								2	2	2	2.0			2	2	3	2.3			
83530	D14								.5	.5	.5	.5			.5	.5	.5	.5			
	D14								.5	.5	.5	.5			.5	.5	.5	.5			

GMD COLOR BADGE LOG SHEET

TEST 44

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1									
									#	TYPE	(ppm)	FERANT (hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
84323	D12	4/20	.375	none	4	7.5	40	25	8	7.5	7.8	7.5	7.5	7.5				7.5			
	D12								8	7.5	7.8	7.5	7.5	7.5				7.5			
84311	D13								8	8.5	8.3	8	8.5	8.3				8.3			
	D13								8	8.5	8.3	8	8.5	8.3				8.3			
59646	D13								9	9	9.0	9	9	9.0				9.0			
	D12								9	9	9.0	9	9	9.0				9.0			
59448	D14								9.5	9	9.3	9	9.5	9.3				9.3			
	D14								9.5	9	9.3	9	9.5	9.3				9.3			

GMD COLOR BADGE LOG SHEET

TEST 45

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT (hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
82407	D12	4/20	.375	none	2	3.75	40	25	5	5	5.0								5.0			
	D12								5	4.5	4.8											
83461	D13								4	4.5	4.3											
	D13								5.5	6	5.8											
59584	D13								7	7	7.0											
	D12								7	7	7.0											
59562	D14								7	7	7.0											
	D14								7	7	7.0											

GMD COLOR BADGE LOG SHEET

TEST 46

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
83439	D12	4/20	.375	none	16	30	40	25	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5
	D12													
82331	D13			D13					9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5
	D13													
59468	D13			D12					9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5
	D12													
59387	D14			D14					9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5	9.5 9.5
	D14													

GMD COLOR BADGE LOG SHEET

TEST 47

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
82400	D12	4/21	.34	none	2	3.4	75	25	5 5	5.5 6	5.3 5.5	5.5 6	5.5 6	5.5 6.0
	D12													
83448	D13			D13					5.5 6	5.5 6	5.5 6.0	6 6	6 6.5	6.0 6.3
	D13													
59484	D13			D12					8 9	7 8	7.5 8.5	7 7.5	7.5 8	7.3 7.8
	D12													
59385	D14			D14					5.5 6	6 6	5.8 6.0	5 6	5.5 6	5.3 6.0
	D14													

GMD COLOR BADGE LOG SHEET

TEST 48

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84241	D12	4/21	.34	none	.25	.425	75	25	.5 .5	.5 .5	.5 .5	.5 .5	.5 .5	.5 .5
	D12													
84308	D13			D13					.5 .5	.5 .5	.5 .5	.5 .5	.5 .5	.5 .5
	D13													
59569	D13			D12					1 1.5	1 1.5	1.0 1.5	1 1.5	1 1.5	1.0 1.5
	D12													
59557	D14			D14					1.5 1.5	1.5 1.5	1.5 1.5	1.5 1.5	1.5 1.5	1.5 1.5
	D14													

GMD COLOR BADGE LOG SHEET

TEST 49

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
82363	D12	4/25	.419	none	7.6	15.922	40	25	6						6.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	D12								6						6.0	9	9	9	9	9.0	9.0	9.0
84246	D13			D13					6						6.0	9	9	9	9	9.0	9.0	9.0
	D13								6						6.0	9	9	9	9	9.0	9.0	9.0
59421	D13			D12					7						7.0	9	9	8.5	8.8			
	D12								7						7.0	9	9	8.5	8.8			
59478	D14			D14					7.5						7.5	9	9	8.5	8.8			
	D14								7						7.0	9	9	8.5	8.8			

GMD COLOR BADGE LOG SHEET

TEST 50

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
82376	D12	4/26	.38	none	.25	.475	70	25	.5	.5					.5	2.0	2.0	2.0				
	D12								.5	.5					.5	1	1	1.0				
83459	D13			D13					.5	.5					.5	1	1.5	1.3				
	D13								.5	.5					.5	1	1	1.0				
59593	D13			D12					.5	1					.8	1.5	1.5	1.5				
	D12								1.5	2					1.8	2	2	2.0				
59497	D14			D14					1.5	3					2.3	4	4	4.0				
	D14								1	2					1.5	2	2	2.0				

GMD COLOR BADGE LOG SHEET

TEST 51

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83470	D12	4/26	.4	none	1	2	70	25	5	5					5.0	6.0	6.0	6.0				
	D12								4	7.5					5.8	5	4.5	4.8				
82332	D13			D13					3	3.5					3.3	4	4	4.0				
	D13								3	3.5					3.3	4	4	4.0				
59491	D13			D12					4.5	5					4.8	4.5	4.5	4.5				
	D12								5	6					5.5	5.5	5	5.3				
59519	D14			D14					5.5	5.5					5.5	5.5	5.5	5.5				
	D14								6	6					6.0	6	6	6.0				

GMD COLOR BADGE LOG SHEET

TEST 52

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1												
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver
82380	D12	4/27	3.6	none	.5	9	40	25	5.5	6	5.8	9.0	9.0	9.0	9.0	5	5.5	5.3	9	9	9.0	9.0	9.0	
	D12																							
82347	D13								5	5.5	5.3	8	8.5	8.3	8.3	5	5.5	5.3	8	8.5	8.3	8.3	8.3	8.3
	D13																							
59607	D13								8	9	8.5	9.5	9.5	9.5	9.5	9.5	8	9	8.5	9.5	9.5	9.5	9.5	9.5
	D12																							
59399	D14								7	8	7.5	9.5	9.5	9.5	9.5	9.5	8	9	8.5	9.5	9.5	9.5	9.5	9.5
	D14																							

GMD COLOR BADGE LOG SHEET

TEST 53

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1												
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver
83460	D12	4/28	1.2	none	3	18	40	25	7	6	6.5	7.5	8.0	7.8	7.8	6	6	6.0	5.5	8	6.8	6.8	6.8	
	D12																							
84297	D13								7	6.5	6.8	8	8	8.0	8.0	6	6.5	6.3	7.5	7.5	7.5	7.5	7.5	7.5
	D13																							
59551	D13								9.5	9	9.3	9	9	9.0	9.0	9.5	9	9	9.3	9.5	9	9.3	9.3	9.3
	D12																							
59513	D14								9.5	8.5	9.0	9.5	9	9.3	9.3	9.5	8.5	8.8	9.5	9	9.3	9.5	9.3	9.3
	D14																							

GMD COLOR BADGE LOG SHEET

TEST 54

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1												
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3	Aver
83516	D12	4/28	1.07	none	.25	1.34	40	25	1	1	1.0	4.0	4.5	4.3	4.3	.5	.5	.5	.5	2	3.5	2.8	2.8	
	D12																							
82370	D13								.5	1	.8	2	4	3.0	3.0	1	1	1.0	4	4.5	4.3	4.3	4.3	4.3
	D13																							
59457	D13								2.5	3	2.8	4.5	4	4.3	4.3	1.5	2	1.8	2.5	3	2.8	2.8	2.8	2.8
	D12																							
59450	D14								2	2	2.0	3	3	3.0	3.0	1.5	2	1.8	2	2	2.0	2.0	2.0	2.0
	D14																							

GMD COLOR BADGE LOG SHEET

TEST 55

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP	T=0			T=1			
								1	2	3 Aver	1	2	3 Aver	
82345	D12	4/28	1.07	none	1	5.35	40	25	4.5	5	4.8	6.0	6.0	6.0
	D12								4.5	4.5	4.5	5	6	5.5
83518	D13								4.5	4.5	4.5	5	6	5.5
	D13								4	4	4.0	4.5	6.5	5.5
59461	D13								6	6.5	6.3	9	7	8.0
	D12								6	7	6.5	8	7	7.5
59458	D14								6	6	6.0	9	9	9.0
	D14								5.5	7	6.3	8	8	8.0

GMD COLOR BADGE LOG SHEET

TEST 56

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP	T=0			T=1			
								1	2	3 Aver	1	2	3 Aver	
83471	D12	5/2	1.1	none	.25	1.375	70	25	1	.5	.8	2.0	2.0	2.0
	D12								1	1	1.0	3.5	3	3.3
84227	D13								.5	.5	.5	1.5	2	1.8
	D13								.5	.5	.5	1.5	2	1.8
59414	D13								4	4.5	4.3	4	4	4.0
	D12								4	4	4.0	4	4	4.0
59390	D14								4.5	4.5	4.5	4.5	5	4.8
	D14								4.5	5	4.8	4.5	5	4.8

GMD COLOR BADGE LOG SHEET

TEST 57

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP	T=0			T=1			
								1	2	3 Aver	1	2	3 Aver	
82352	D12	5/3	1.17	none	2	11.7	70	25	9	9	9.0	9.5		9.5
	D12								9	9	9.0	9.5		9.5
84239	D13								9	9	9.0	9.5		9.5
	D13								9	9	9.0	9.5		9.5
59522	D13								9.5	9.5	9.5	9.5		9.5
	D12								9.5	9.5	9.5	9.5		9.5
59487	D14								9	8	8.5	9		9.0
	D14								9	9	9.0	9.5		9.5

GMD COLOR BADGE LOG SHEET

TEST 58

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83496	D12	5/4	.15	none	1.3	.975	40	25	1.5	1.5	1.5	1.5	1.5	3.0	4.0	3.5						
	D12								1.5	1.5	1.5	1.5	1.5	4	4	4.0						
84316	D13								1	1	1.5	1.2	1	3	3	3.0						
	D13								1	1	1	1.0	1	1.5	2	1.8						
59439	D13								3.5	4	2.5	3.3	3	4	4.5	4.3						
	D12								3	3	2	2.7	3	4	4	4.0						
59416	D14								3	3	3	3.0	3	4	4.5	4.3						
	D14								3.5	4	3	3.5	3	4	4.5	4.3						

GMD COLOR BADGE LOG SHEET

TEST 59

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83443	D12	5/5	5.9	none	.25	7.38	40	25	2	4	3.0	8.5	9.0	8.8								
	D12								2	3	2.5	8	8.5	8.3								
84288	D13								2.5	4	3.3	7.5	8	7.8								
	D13								2.5	3	2.8	7	7.5	7.3								
59423	D13								5	6	5.5	9.5	9.5	9.5								
	D12								5	6	5.5	9	9	9.0								
59395	D14								6	6	6.0	9.5	9.5	9.5								
	D14								6	7	6.5	9.5	9.5	9.5								

GMD COLOR BADGE LOG SHEET

TEST 60

I.D.	BADGE	DATE	Hz	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
83482	D12	5/5	.095	none	.25	.24	40	25	.5	.5	.5	1.0	1.0	1.0								
	D12								.5	.5	.5	1	1	1								
83442	D13								.5	.5	.5	1	1	1								
	D13								.5	.5	.5	1	1	1								
59594	D13								.5	.5	.5	.5	.5	.5								
	D12								.5	.5	.5	.5	.5	.5								
59451	D14								.5	.5	.5	.5	.5	.5								
	D14								.5	.5	.5	.5	.5	.5								

GMD COLOR BADGE LOG SHEET

TEST 61

I.D. #	BADGE TYPE	DATE (ppm)	Hz	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
83433	D12	5/5	.095	none	.25	.24	70	25	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	1	1	1.0
83529	D13								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5
59412	D13								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
59514	D14								.5	.5	.5	.5	.5	.5
	D14								.5	.5	.5	1	1	1.0

GMD COLOR BADGE LOG SHEET

TEST 62

I.D. #	BADGE TYPE	DATE (ppm)	Hz	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84252	D12	5/8	.1	none	4	4	40	25	3.5	4	3.8	4.5	5.0	4.8
	D12								3.5	4	3.8	4.5	5	4.8
84262	D13								3.5	4	3.8	4.5	5	4.8
	D13								3.5	4	3.8	4.5	5	4.8
59418	D13								4.5	4	4.3	4.5	4.5	4.5
	D12								4.5	4	4.3	4.5	4.5	4.5
59656	D14								4.5	4	4.3	4.5	4.5	4.5
	D14								4	4	4.0	4	4.5	4.3

GMD COLOR BADGE LOG SHEET

TEST 63

I.D. #	BADGE TYPE	DATE (ppm)	Hz	INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
82385	D12	5/9	.1	none	2	2	40	25	2	2	2.0	5.0	4.0	4.0
	D12								3	3	3.0	5	4.5	4.2
82334	D13								1.5	2	1.8	4	2	4
	D13								2	2	2.0	4	3	3.3
59440	D13								3.5	4.5	4.0	4	4.5	3
	D12								3.5	4	3.8	4	4.5	3.8
59436	D14								3.5	4	3.8	3	4	2
	D14								2.5	2	2.3	3	2.5	2.5

GMD COLOR BADGE LOG SHEET

TEST 64

I.D.	BADGE	DATE	Hz	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
84258	D12	5/9	.1	none	2	2	70	25	4	5	4.5	4.5	4.5	4.5	4.5	2.5	4.5	3.5	4.5	4.5	4.5	4.5	
	D12																						
84294	D13								2	4.5	3.3	4.5	4.5	4.5	4.5	3	4	3.5	4.5	4.5	4.5	4.5	4.5
	D13																						
59646	D13								3.5	4.5	4.0	4.5	4.5	4.5	4.5	2.5	2	2.3	5	5	5.0	5.0	5.0
	D12																						
59564	D14								3	3	3.0	4	4	4.0	4.0	2.5	3	2.8	4.5	4.5	4.5	4.5	4.5
	D14																						

GMD COLOR BADGE LOG SHEET

TEST 65

I.D.	BADGE	DATE	Hz	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
83505	D12		.1	none	16	16	40	25	7	9	7	7.7	8.0	8.0	8.0	8.0	8	9	7.8	7.5	8	8	7.8
	D12																						
82383	D13								6	8	7	7.0	7	7	7.3	8	8	7.7	7	8	8	7.7	7.7
	D13																						
59359	D13								7	8	8	7.7	8	8	8.0	9	9	8.7	9	9	8	8	8.0
	D12																						
59625	D14								8	9	8	8.3	9.5	9.5	9.5	8	9	8.7	9	9	8	8	8.8
	D14																						

GMD COLOR BADGE LOG SHEET

TEST 66

I.D.	BADGE	DATE	Hz	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1											
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver	
82335	D12	5/10	.1	none	8	8	40	25	7	7	7.0	7.0	7.0	6.5	6.5	5	5	5.0	6	7	6.5	6.5	
	D12																						
82403	D13								6.5	7	6.8	7	6	6.5	6.5	6	6	6.0	7	6	6	6.5	6.5
	D13																						
59548	D13								6	6	6.0	5	7	6.5	6.0	6	6	6	7	6	6	6.0	6.0
	D12																						
59443	D14								5	4.5	4.8	5	6	5.5	5.5	4	4	4.0	4	5	4.5	4.5	4.5
	D14																						

GMD COLOR BADGE LOG SHEET

TEST 67

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1				
							1	2	3 Aver	1	2	3 Aver		
38647		8/18	.122	none	.25	.305	35	25	1 1	1 1	1.0 1.0	1.5 1	1.5 1	1.5 1.0
38867									.5 .5	.5 .5	.5 .5	.5 .5	.5 .5	.5 .5
38844									1 1	1 1	1.0 1.0	1.5 1	1.5 1	1.5 1.0

GMD COLOR BADGE LOG SHEET

TEST 68

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1				
							1	2	3 Aver	1	2	3 Aver		
38905		8/21	.137	none	2	2.74	35	25	3 3	3 3	3.0 3.0	4.0 3.5	4.0 3	4.0 3.3
38975									3 2.5	2.5 2.5	2.8 2.5	4 2.5	4 3	4.0 2.8
38971									3 3	3 3	3.0 3.0	4 3	4 3	4.0 3.0

GMD COLOR BADGE LOG SHEET

TEST 69

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	T=0			T=1				
							1	2	3 Aver	1	2	3 Aver		
38873		8/21	.137	none	1.5	2.055	35	25	3 2	3 2	3.0 2.0	3.5 2	3.5 2	3.5 2.0
38963									3 2	2.5 2.5	2.8 2.3	3 3	3.5 3	3.3 3.0
38876									2 2	2 1.5	2.0 1.8	2 2	2.5 2	2.3 2.0

GMD COLOR BADGE LOG SHEET

TEST 70

I.D. #	BADGE TYPE	DATE	Hz (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
39003		8/21	.137	none	.1	.137	35	25	2 2	2.5 2	2.3 2.0	2.5 2	2.5 2	2.5 2.0
38682									2.5 2.5	2.5 2.5	2.5 2.5	3 2.5	3 2.5	3.0 2.5
38845									2.5 2	2.5 2	2.5 2.0	3 2	3 2	3.0 2.0

GMD COLOR BADGE LOG SHEET

TEST 71

I.D. #	BADGE TYPE	DATE	Hz (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
38996		8/21	.137	none	.5	.685	35	25	2 2	2 1.5	2.0 1.8	2.5 2	2.5 1.5	2.5 1.8
38974									2 2	2 2	2.0 2.0	2 2	2 2	2.0 2.0
39004									1 2	2 1.5	1.5 1.8	2.5 1.5	3 1.5	2.8 1.5

GMD COLOR BADGE LOG SHEET

TEST 72

I.D. #	BADGE TYPE	DATE	Hz (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
38960		8/22	.121	none	2	2.41	65	25	3 3	3 3	3.0 3.0	3.0 3	3.0 3	3.0 3.0
38943									3 2.5	3 2	3.0 2.3	4 2	3.5 2.5	3.8 2.3
38747									4 3	2 3.5	3.0 3.3	4 3	4 3	4.0 3.0

GMD COLOR BADGE LOG SHEET

TEST 73

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
								1	2	3 Aver	1	2	3 Aver		
38998		8/22	.134	none	2	2.68	<10	25	2 3	1.5 2	2 3.5	1.8 2.8	4.0 3.5	4.0 4	4.0 3.8
38864									2 2	2.5 2.5	2 3	2.2 2.5	4.5 3	4.5 3	4.5 3.0
38748									2 3	2 3	2 3.5	2.0 3.2	4 4	4.0 4	4.0 4.0

GMD COLOR BADGE LOG SHEET

TEST 74

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
38874		8/23	.211	none	2	4.22	<10	25	2.5 3.5	3 3	2 4	2.5 3.5	4.5 4	5.0 4	5.0 4	4.8 4.0
38866									2 3.5	2.5 3	2 4	2.2 3.5	4 4	4 4	4 4	4.0 4.0
38865									2.5 3	2.5 3	2.5 2.5	2.5 2.8	4.5 3	5 3.5	4 3	4.5 3.2

GMD COLOR BADGE LOG SHEET

TEST 75

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1					
								1	2	3 Aver	1	2	3 Aver			
38928		8/23	.23	none	.25	.58	35	25	1 1	1.5 1.5	1.5 1.5	1.3 1.3	1.5 2	2.0 2	2.0 2	1.8 2.0
38834									1 1	2 1.5	2 1.2	1.7 1.2	2 1	2 1	2.5 1	2.2 1.0
38838									1 1	1.5 1.5	1.5 1.2	1.3 1.2	2 1.5	2 1.5	2 1	2.0 1.3

GMD COLOR BADGE LOG SHEET

TEST 76

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
38881		8/23 .228	none	1	2.28	35	25	2.5 2	2.5 2	2.7 2.0	2.5 2.5	4.0 2	3.3 2.3
38751								2.5 2.5	2.5 3	2.7 2.7	3 3	3.5 3	3.3 3.0
38955								2.5 2	2.5 2	2.7 2.0	2.5 2	4 2	3.3 2.0

GMD COLOR BADGE LOG SHEET

TEST 77

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
								1	2	3 Aver	1	2	3 Aver	
38710		8/23 .228	none	.5	1.14	35	25	1.5 2	2 2.5	1.5 2.2	2.5 2.5	2.0 2.5	2.3 2.5	
38737								2 1.5	2 1.5	2 1.5	2.0 1.5	3 2	3 1.5	3.0 1.8
38752								1.5 1.5	2 1.5	1.5 1.5	1.7 1.5	2.5 2	2 1.5	2.3 1.8

GMD COLOR BADGE LOG SHEET

TEST 78

I.D. #	BADGE TYPE	DATE (ppm)	Hz INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
38957		8/24 .213	none	2	4.26	35	25	3 3.5	3 3	3.0 3.3	3.5 4	3.5 4	3.5 4.0
38664								3.5 2.5	3.5 3	3.5 2.8	4.5 3	4.5 3	4.5 3.0
38672								3 3	3 3	3.0 3.0	4 3.5	4 3.5	4.0 3.5

GMD COLOR BADGE LOG SHEET

TEST 79

I.D.	BADGE	DATE	Hz	INTER-FERANT	TIME	DOSE	RH	TEMP	T=0			T=1							
									(ppm)	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
38956		8/24	.21	none	2	4.2	64	25		4	4			4.0	4.0	4.0		4.0	
										2.5	2.5			2.5	2.5	2.5		2.5	
38826										4	4			4.0	4	4		4.0	
										4	3.5			3.8	3.5	3.5		3.5	
38858										4.5	4.5			4.5	4.5	4		4.3	
										3	3			3.0	3	3		3.0	

GMD COLOR BADGE LOG SHEET

TEST 80

I.D.	BADGE	DATE	MMH	INTER-FERANT	TIME	DOSE	RH	TEMP	POST MMH			POST INTERFERAN									
									#	TYPE	(ppm)	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
38735		9/14	.178	NO2	1	.89	45	25	2.0	2.0				2.0		2	2		2.0		
				5 ppm						2	2.5			2.3		2	2.5		2.3		
38856			.178	5						1	1			1.0		1	1		1.0		
										2	2			2.0		2	2		2.0		
38966			.178	5						1.5	1.5			1.5		2	2		2.0		
										3	3			3.0		3	3		3.0		
38832	CON		.178	0						1	1			1.0		1.5	1.5		1.5		
										2	2			2.0		2	2		2.0		

GMD COLOR BADGE LOG SHEET

TEST 81

I.D.	BADGE	DATE	INTER-FERANT	MMH	TIME	DOSE	RH	TEMP	POST INTERFERANT			POST MMH									
									#	TYPE	(ppm)	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
38944		9/14	NO2	.178	1	.89	45	25	.5	.5				.5		1.0	1.5		1.3		
			5 ppm							.5	.5			.5		2.5	2.5		2.5		
38712			5	.178						.5	.5			.5		1	1.5		1.3		
										.5	.5			.5		2	2.5		2.3		
38979			5	.178						.5	.5			.5		1	1.5		1.3		
										.5	.5			.5		2.5	2.5		2.5		
38839	CON		5	0						.5	.5			.5		.5	.5		.5		
										.5	.5			.5		.5	.5		.5		

GMD COLOR BADGE LOG SHEET

TEST 82

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
								1	2	3 Aver	1	2	3 Aver	
38734		9/14	.178	none	1	.89	45	25	1 3	1.5 2.5	1.3 2.8	2.0 3	2.5 3	2.3 3.0
38912									1 2	1 2	1.0 2.0	1.5 2	1.5 2	1.5 2.0
38652									2 2.5	2 3	2.0 2.8	3 3	3 3	3.0 3.0
38678									1.5 2.5	1.5 2	1.5 2.3	2.5 2.5	3 3	2.8 2.8

GMD COLOR BADGE LOG SHEET

TEST 83

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	POST MMH			POST INTERFERAN		
								1	2	3 Aver	1	2	3 Aver
38717		9/15	.164 NH3 20.4 ppm	1	.82	45	25	1.5 3	1.5 3	1.5 3.0	3 3	3 3.5	3.0 3.3
38868			.164	20.4				1 2	1.5 2	1.3 2.0	2 2	2 2	2.0 2.0
38910			.164	20.4				2 2.5	2 2.5	2.0 2.5	3 3	3 3.5	3.0 3.3
38959	CON		.164	0				1.5 2	1.5 2	1.5 2.0	2 2	2 2	2.0 2.0

GMD COLOR BADGE LOG SHEET

TEST 84

I.D. #	BADGE TYPE	DATE INTER- FERANT	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	POST INTERFERANT			POST MMH		
								1	2	3 Aver	1	2	3 Aver
38711		9/15	NH3 20.4 ppm	.164	1	.82	45	.5	.5	.5	3.0 3	3.0 3	3.0 3.0
38825			20.4	.164				.5	.5	.5	3 3	2.5 2.5	2.8 2.8
38827			20.4	.164				.5	.5	.5	3 3	2.5 2	2.8 2.5
38833	CON		20.4	0				.5	.5	.5	1 .5	.5 .5	.8 .5

GMD COLOR BADGE LOG SHEET

TEST 85

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	POST MMH			POST INTERFERAN		
									1	2	3 Aver	1	2	3 Aver
38925		9/19	.198	FREONS 29.4 ppm	1	.99	45	25	1 2	1 2	1.0 2.0	1.5 2	2 2	1.8 2.0
38753			.198	29.4					1.5 3	2 3	1.8 3.0	2 3	2.5 3	2.3 3.0
38990			.198	29.4					1.5 2.5	2 3	1.8 2.8	2 3	2.5 3	2.3 3.0
38749	CON		.198	0					1 2	2 2	1.5 2	2 2	2 2	2.0

Freon 11, 12, 114: 8.6, 10.6, 10.2 ppm

GMD COLOR BADGE LOG SHEET

TEST 86

I.D. #	BADGE TYPE	DATE	INTER- FERANT	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	POST INTERFERANT			POST MMH		
									1	2	3 Aver	1	2	3 Aver
38903		9/19	FREONS 29.4 ppm	.198	1	.99	45	25	0 0	0 0	.0 .0	2.0 2.5	2.0 2.5	2.0 2.5
38842			29.4	.198					0 0	0 0	.0 .0	1.5 2	2 2	1.8 2.0
39005			29.4	.198					0 0	0 0	.0 .0	1.5 2	2 2	1.8 2.0
38671	CON		29.4	0					0 0	0 0	.0 .0	0 0	0 0	.0

CON- Control badges were not exposed to the second vapor

GMD COLOR BADGE LOG SHEET

TEST 87

I.D. #	BADGE TYPE	DATE	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	WHEEL DESIGN	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
39006	VAN	12/22	.28	.75	1.05	43	25	OLD	4.5	4.5	4	4.3	4.0	4.5	4.0	4.2
								NEW	2.5	2.5	3	2.7	2.5	2.5	2.5	2.5
	PDAB							OLD	.5	1	1	.8	.5	1	3	1.5
								NEW	.5	1	1	.8	1	1	1	1.0
38687	VAN							OLD	3	2	3	2.7	3	2	2	2.3
								NEW	2	2	2	2.0	2	2	2	2.0
	PDAB							OLD	1	1.5	1.5	1.3	1.5	2.0	3.0	2.2
								NEW	1	1	1.5	1.2	1.5	1.5	2	1.7
38713	VAN							OLD	4	4	4	4.0	4.0	3.0	4	3.7
								NEW	2.5	2.5	2.5	2.5	2.5	2.5	2	2.3
	PDAB							OLD	1	1	2	1.3	1.5	2	3	2.2
								NEW	1	1	1.5	1.2	1.5	1.5	2	1.7
39008	VAN							OLD	2	1.5	2	1.8	2	1	1.5	1.5
								NEW	1.5	1.5	1.5	1.5	1.5	1.5	1	1.3
	PDAB							OLD	.5	.5	1	.7	.5	1	1	.8
								NEW	.5	.5	1	.7	.5	1	1	.8

GMD COLOR BADGE LOG SHEET

TEST 88

I.D. #	BADGE TYPE	DATE	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	WHEEL DESIGN	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
38663	VAN	12/22	.28	4	5.6	43	25	OLD	7	8	8	7.7	7.8	7.5	7.6	
								NEW	4	4	3.5	3.8	3.5	3.5	3.5	
	PDAB							OLD	7	8	8	7.7	7	8	7.5	
								NEW	3.5	4	4	3.8	4	4	4	
38649	VAN							OLD	8	9	8	8.3	8	7.5	7.8	
								NEW	4	5	5	4.7	4	4	4.0	
	PDAB							OLD	7	7.5	8	7.5	7.0	8.0	7.5	
								NEW	4	4	4	4.0	4	4	4.0	
38650	VAN							OLD	8	8	8	8.0	8.0	8.0	8.0	
								NEW	4	4	4	4.0	4	4	4.0	
	PDAB							OLD	7.5	7.5	8	7.7	7	7.5	7.3	
								NEW	4	3.5	4	3.8	3.5	4	3.8	
38743	VAN							OLD	8	7	7.5	7.5	7	7	7.0	
								NEW	4	3.5	4	3.8	3.5	4	3.8	
	PDAB							OLD	7.5	7.5	8	7.7	7	7	7.0	
								NEW	3.5	4	4	3.8	3.5	4	3.8	

GMD COLOR BADGE LOG SHEET

TEST 89

I.D. #	BADGE TYPE	DATE	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	WHEEL DESIGN	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
38898	VAN	12/22	.28	1.75	2.45	43	25	OLD	6		6.0			
								NEW	3		3.0			
	PDAB							OLD	3.5		3.5			
								NEW	2		2.0			
38754	VAN							OLD	5		5.0			
								NEW	3		3.0			
	PDAB							OLD	5		5.0			
								NEW	3		3.0			
38741	VAN							OLD	5		5.0			
								NEW	3		3.0			
	PDAB							OLD	4.5		4.5			
								NEW	2.5		2.5			
38715	VAN							OLD	5		5.0			
								NEW	3		3.0			
	PDAB							OLD	4.5		4.5			
								NEW	2		2.0			

GMD COLOR BADGE LOG SHEET

TEST 90

I.D. #	BADGE TYPE	DATE	MMH (ppm)	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	WHEEL DESIGN	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
39001	VAN	1/9/90	.234	17.25	20.1825	35	25	OLD	9.5	9	9.2	9.5	9.0	9.3
								NEW	5.5	5	4.5	5.0	5	5.0
	PDAB							OLD	9.5	9	9.2	9.5	9	9.3
								NEW	5	5	5.0	5	5	5.0
38993	VAN							OLD	9.5	9	9.5	9.3	9.5	9.5
								NEW	5.5	5	5.2	5.5	5	5.3
	PDAB							OLD	9.5	9	9.5	9.3	9.5	9.5
								NEW	5.5	5	5.2	5.5	5	5.3
38980	VAN							OLD	9.5	9	9.5	9.3	9.5	9.5
								NEW	5	5	5.0	5	5.5	5.3
	PDAB							OLD	9.5	9	9.2	9.5	9	9.3
								NEW	5.5	5	5.2	5.5	5	5.3
38985	VAN							OLD	9.5	9	9.5	9.3	9.5	9.3
								NEW	5	5	5.0	5	5	5.0
	PDAB							OLD	9.5	9	9.2	9.5	9.5	9.5
								NEW	5	5	5.0	5	5	5.0

GMD COLOR BADGE LOG SHEET

TEST 91

I.D. #	BADGE TYPE	DATE (ppm)	MMH (hrs)	TIME TLV-hrs	DOSE (%)	RH (C)	TEMP (C)	WHEEL DESIGN	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
38995	VAN	1\10\90	.195	7.5	7.3125	45	25	OLD	9.5	9	9	9.2	9.0			9.0
								NEW	5	5	5	5.0	5			5.0
	PDAB							OLD	9	9	8.5	8.8	8.5			8.5
								NEW	4.5	4.5	4.5	4.5	4.5			4.5
39013	VAN							OLD	8	9	9	8.7	8			8.0
								NEW	4	3.5	3.5	3.7	4			4.0
	PDAB							OLD	7.5	7	8.5	7.7	8.5			8.5
								NEW	4	4	4.5	4.2	4			4.0
38982	VAN							OLD	9	9	9	9.0	9.0			9.0
								NEW	5	4.5	5	4.8	5			5.0
	PDAB							OLD	9	9	8.5	8.8	9			9.0
								NEW	5	4.5	4.5	4.7	5			5.0
39000	VAN							OLD	9	8	8.5	8.5	8.5			8.5
								NEW	4	4	4	4.0	4			4.0
	PDAB							OLD	9	8	8.5	8.5	8.5			8.5
								NEW	4.5	4.5	4.5	4.5	4.5			4.5

APPENDIX B
Wiltech Data Sheets

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84256	D12	2/27	.12	none	.25	.15	31		.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
84285	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
83515	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
59588	D14								.5	.5	.5	.5	.5	.5
	D14								.5	.5	.5	.5	.5	.5
59561	D14								.5	.5	.5	.5	.5	.5
	D14								.5	.5	.5	.5	.5	.5
59394	D14								.5	.5	.5	.5	.5	.5
	D14								.5	.5	.5	.5	.5	.5
81203	D12								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5
81187	D12								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5
83451	D12								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5

I.D.	#	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
										1	2	3	Aver	1	2	3	Aver
83495		D12	2/27	.12	none	.5	.3	31		.5	.5	.5	.5	.5	.5	.5	.5
		D12								.5	.5	.5	.5	.5	.5	.5	.5
83416		D12								.5	.5	.5	.5	.5	.5	.5	.5
		D12								.5	.5	.5	.5	.5	.5	.5	.5
83519		D12								.5	.5	.5	.5	.5	.5	.5	.5
		D12								.5	.5	.5	.5	.5	.5	.5	.5
59618		D14								.5	.5	.5	.5	.5	.5	.5	.5
		D14								1	1	1	1.0	1	1	1	1.0
59589		D14								1	1	1	1.0	1	1	1	1.0
		D14								1	1	1	1.0	1.5	1	1.5	1.3
59498		D14								.5	.5	.5	.5	.5	.5	.5	.5
		D14								1	1	1	1.0	1	1	1	1.0
81231		D12								.5	.5	.5	.5	.5	.5	.5	.5
		D13								.5	.5	.5	.5	.5	.5	.5	.5
85552		D12								.5	.5	.5	.5	.5	.5	.5	.5
		D13								.5	.5	.5	.5	.5	.5	.5	.5
83519		D12								.5	.5	.5	.5	.5	.5	.5	.5
		D13								.5	.5	.5	.5	.5	.5	.5	.5
84231		D12	2/27	.12	none	16	9.6	31		9	9	8.5	8.8	9	9	8.5	8.8
		D12								9	9	9	9.0	9	9	9	9.0
59404		D14								9	9	8.5	8.8	9	9	9	9.0
		D14								9	9	8.5	8.8	9	9	9.5	9.2
83452		D12								9	9	9	9.0	9	9	9	9.0
		D13								9	9	9	9.0	9	9	8.5	8.8

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3	Aver	1	2	3	Aver
82369	D12	3/2	.12	none	1	.6	30		.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	1.5	1	2	1.5
84274	D12								.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5	.5	.5
59420	D14								1	1	1	1.0	1	1	1	1.0
	D14								2	2	2	2.0	2	1.5	2	1.8
59517	D14								.5	.5	.5	.5	.5	.5	.5	.5
	D14								2	1.5	2	1.8	2	1.5	2	1.8
85583	D12								2	1.5	2	1.8	2	1.5	2	1.8
	D13								.5	.5	.5	.5	1.5	1.5	1.5	1.5
85511	D12								1	1	1	1.0	1	1	1	1.0
	D13								.5	.5	.5	.5	.5	.5	1.5	.8
83524	D12	3/2	.12	none	16	9.6	30		9	9	9	9.0	9.5	9.5	9	9.3
	D12								9	9.5	9	9.2	9.5	9.5	9.5	9.5
59639	D14								9	9.5	9.5	9.3	9.5	9.5	9.5	9.5
	D14								9	9.5	9.5	9.3	9.5	9.5	9.5	9.5
81179	D12								9	9.5	9.5	9.3	9.5	9.5	9.5	9.5
	D13								9	9.5	9	9.2	9.5	9.5	9.5	9.5

GMD COLOR BADGE LOG SHEET

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3	Aver	1	2	3	
83473	D12	3/3	.12	none	2	1.2	30		1	.5	.5	.7	4.0	1.5	2.0	2.5
	D12								4	3	2.5	3.2	5	4.5	4	4.5
84282	D12								1	.5	1	.8	2	1.2	2	1.7
	D12								2	1.5	2	1.8	4	3.5	3.5	3.7
84280	D12								4	3.5	3	3.5	5	5	5	5.0
	D12								3.5	2.5	3.5	3.2	4.5	4.5	4	4.3
59567	D14								4	4.5	4	4.2	5	5	4	4.7
	D14								5	4	4	4.3	4	4	3.5	3.8
59483	D14								5	5	5	5.0	5	5	5	5.0
	D14								5	4.5	4.5	4.7	5	4.5	4	4.5
59636	D14								3	3	3	3.0	3	3	3	3.0
	D14								4	2.5	3.5	3.3	4	4	4.5	4.2
83464	D12								4	4	4	4.0	5	4.5	4	4.5
	D13								2	2	2.5	2.2	4	4	3.5	3.8
83497	D12								4	4	4	4.0	4	4	4	4.0
	D13								2	1.5	2	1.8	4	3.5	2.5	3.3
85545	D12								4	4.5	5	4.5	5	5	5	5.0
	D13								4	3.5	3.5	3.7	5	5	5	5.0
82372	D12	3/3	.12		1	.6	30		.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	2	1.5	2	1.8
59547	D14								.5	.5	1	.7	.5	1	1	.8
	D14								1	1.5	1.5	1.3	1.5	1.5	1.5	1.5
81196	D12								2	2	2	2.0	2	2	2.5	2.2
	D13								.5	.5	.5	.5	1.5	1.5	1.5	1.2

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
84230	D12	3/6	.18	none	.25	.225	33		.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
83507	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
84245	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
59521	D14								.5	.5	.5	.5	.5	.5
	D14								1	1	1	1.0	.5	.5
59512	D14								.5	.5	.5	.5	.5	.5
	D14								1.5	1.5	1	1.3	1.5	1.5
59597	D14								.5	.5	.5	.5	.5	.5
	D14								1.5	1.5	1	1.3	1.5	1.3
81252	D12								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5
81191	D12								.5	.5	.5	.5	1	.8
	D13								.5	.5	.5	.5	.5	.5
81181	D12								.5	.5	.5	.5	.5	.5
	D13								.5	.5	.5	.5	.5	.5
84273	D12	3/6	.18	none	.25	.225	33		.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
84300	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5
84265	D12								.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	1.5	1.5
59492	D14								.5	.5	.5	.5	1	.7
	D14								1	1.5	1	1.2	2	1.5
59645	D14								1	1	1	1.0	1	1.0
	D14								1.5	1.5	1	1.3	2	1.5
59538	D14								.5	.5	.5	.5	.5	.5
	D14								1	.5	1	.8	1	1.0
81273	D12								1.5	1.5	1.5	1.5	1.5	1.3
	D13								.5	.5	1	.7	.5	.7
83496	D12								1	1.5	1	1.2	2	1.5
	D13								.5	.5	.5	.5	1	1.0
83510	D12								1	1.5	1	1.2	1	1.0
	D13								.5	.5	.5	.5	.5	.5

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
82349	D12	3/6	.18	none	1	.9	33		.5	.5	.5	.5	2.5	2.5	3	2.7
	D12								.5	1.5	1	1.0	2.5	3	3	2.8
82368	D12								.5	.5	1	.7	1.5	2.5	2	2.0
	D12								.5	.5	.5	.5	2.5	2.5	3	2.7
82390	D12								.5	.5	.5	.5	.5	1	.5	.7
	D12								2	2.5	2	2.2	3.5	3.5	3.5	3.5
59422	D14								1.5	1.5	1	1.3	2	1.5	1	1.5
	D14								3	2.5	2.5	2.7	3	3	3	3.0
59413	D14								2	2	2	2.0	2	2	1	1.7
	D14								4	3.5	4	3.8	4	3.5	3	3.5
59410	D14								2	2	2	2.0	2	2	2	2.0
	D14								4	3.5	4	3.8	3.5	3.5	3.5	3.5
81182	D12								2	2	2	2.0	2.5	2	2	2.2
	D13								.5	.5	.5	.5	1.5	1.5	2	1.7
83477	D12								2	2	2	2.0	2	2	2	2.0
	D13								.5	1.5	1	1.0	2.5	2.5	2	2.3
85549	D12								2	2	2	2.0	2	2	2	2.0
	D13								.5	1	.5	.7	1.5	1	1.5	1.3
84269	D12	3/6	.12	none	16	9.6	33		9	9	9	9.0	9	9	9	9.0
	D12								9	9	9	9.0	9	9	9	9.0
59511	D14								9	9	9	9.0	9	9	9	9.0
	D14								9	8	9	8.7	9	9	9	9.0
85594	D12								9	9	9	9.0	9	9	9	9.0
	D13								9	9	9	9.0	9	9	9	9.0

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
83502	D12	3/7	.43	none	.25	.5375	33		.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	.5	.5	.5	.5
82350	D12								.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	1.5	2.5	1.5	1.8
83472	D12								.5	.5	.5	.5	.5	.5	.5	.5
	D12								.5	.5	.5	.5	1.5	1.5	1.5	1.5
59460	D14								.5	.5	.5	.5	.5	.5	.5	.5
	D14								1	1	1	1.0	1	1	1	1.0
59364	D14								.5	.5	.5	.5	.5	.5	.5	.5
	D14								1	1	1	1.0	1	1	1	1.0
59643	D14								.5	.5	.5	.5	.5	.5	.5	.5
	D14								1	1	1	1.0	1	1	1	1.0
83526	D12								1	1	1	1.0	1.5	1	1.5	1.3
	D13								.5	.5	.5	.5	.5	.5	.5	.5
85600	D12								1	1	1	1.0	1.5	1.5	1.5	1.5
	D13								.5	.5	.5	.5	.5	.5	.5	.5
85579	D12								1	1.5	1	1.2	1.5	1.5	1.5	1.5
	D13								.5	.5	.5	.5	.5	.5	.5	.5
84292	D12	3/7	.43	none	.5	1.075	33		.5	.5	.5	.5	.5	1	.5	.7
	D12								1	1	.5	.8	4.5	5	3.5	4.3
83508	D12								.5	.5	.5	.5	2.5	2.5	3.5	2.8
	D12								2	2	1.5	1.8	5	5	4.5	4.8
82343	D12								.5	.5	.5	.5	2.5	2.5	1.5	2.2
	D12								2.5	2.5	1.5	2.2	4.5	5	5	4.8
59504	D14								1	1	1	1.0	1	1.5	1	1.2
	D14								1.5	2	1.5	1.7	2	2.5	2	2.2
59535	D14								1	1	.5	.8	1.5	1.5	1.5	1.5
	D14								1.5	1.5	1.5	1.5	2.5	2.5	2	2.3
59489	D14								1	1.5	1	1.2	1.5	2	1	1.5
	D14								2	2	1.5	1.8	2.5	3	2	2.5
85606	D12								2.5	2.5	2	2.3	3	2.5	3	2.8
	D13								.5	.5	.5	.5	1.5	1.5	.5	1.2
81176	D12								2	2	2	2.0	2.5	2	2	2.2
	D13								.5	.5	.5	.5	.5	.5	.5	.5
85572	D12								3	3	2	2.7	3	4	3	3.3
	D13								1	.5	1	.8	1	2.5	1.5	1.7

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
									1	2	3 Aver	1	2	3 Aver
83463	D12	3/7	.43	none	1	2.15	33		.5	.5	1 .7	3	3.5	2 2.8
	D12								1	1	1 1.0	3.5	4	2 3.2
82339	D12								1	1	1.5 1.2	2	2	1.5 1.8
	D12								2	1.5	1.5 1.7	2.5	3.5	2.5 2.8
82415	D12								.5	.5	.5 .5	3	3	2.5 2.8
	D12								1	1	.5 .8	3.5	3.5	2.5 3.2
59490	D14								2	2	2 2.0	3	2	2 2.3
	D14								2.5	2.5	2 2.3	3.5	3	3 3.2
59485	D14								2.5	2.5	3 2.7	3	4	2.5 3.2
	D14								3	3	3 3.0	4	4	4 4.0
59612	D14								1.5	2	1 1.5	1.5	1.5	1.5 1.5
	D14								3	3	3 3.0	4	4	4 4.0
83520	D12								5	5.5	5 5.2	6	7	7 6.7
	D13								4.5	5	4.5 4.7	6.5	7.5	7.5 7.2
83484	D12								6	6	5 5.7	6	6	5 5.7
	D13								5	5	6.5 5.5	5.5	6	5.5 5.7
85571	D12								5	5	4.5 4.8	5.5	5.5	5 5.3
	D13								4.5	4.5	4.5 4.5	6	5.5	6.5 6.0
82367	D12	3/7	.43	none	16	34.4	33		9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D12								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
59590	D14								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D14								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
85569	D12								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D13								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
83512	D12								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D13								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
84278	D12	3/8	.43	none	16	34.4	33		9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D12								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
59585	D14								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5
	D14								9.5	9.5	9.5 9.5	9.5	9.5	9.5 9.5

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
								1	2	3	Aver	1	2	3	Aver
83476	D12	4/5 .18	none	2	1.8	33		2	2.5	2.5	2.3	4.5	4.5	4.5	4.5
	D12							2.5	2.5	2.5	2.5	4.5	4	3.5	4.0
83527	D12							.5	.5	.5	.5	3.5	4	2.5	3.3
	D12							1	1	.5	.8	4.5	4	3.5	4.0
82381	D12							.5	1	.5	.7	1	1.5	1.5	1.3
	D12							2	2.5	1.5	2.0	2.5	3	3	2.8
59432	D14							4.5	4	4	4.2	5.5	5	4.5	5.0
	D14							4	4	4	4.0	4.5	5	4.5	4.7
59378	D14							4	4	4.5	4.2	4.5	4.5	4.5	4.5
	D14							5	4.5	4.5	4.7	5	5	4.5	4.8
59475	D14							4.5	5	4.5	4.7	5	5.5	5	5.2
	D14							5	5	4.5	4.8	5.5	5.5	5	5.3
85576	D12							4.5	4.5	4	4.3	5	5	4.5	4.8
	D13							4.5	4.5	4	4.3	5	5	4.5	4.8
85591	D12							3.5	4	4.5	4.0	5.5	5.5	4.5	5.2
	D13							1.5	3.5	1.5	2.2	4.5	4.5	4.5	4.5
81220	D12							4.5	4.5	4.5	4.5	5.5	6	5.5	5.7
	D13							3	4	2.5	3.2	4.5	4.5	3.5	4.2
82396	D12	4/5 .18	none	16	14.4	33		4.5	5	4.5	4.7	6	6	7.5	6.5
	D12							5	5	5.5	5.2	7	6	6.5	6.5
84254	D12							4.5	5	4.5	4.7	6	6	6.5	6.2
	D12							5	5	4.5	4.8	6.5	6	6.5	6.3
59644	D14							6	8	7	7.0	7	8	8	7.7
	D14							7.5	8	8	7.8	8	8	8	8.0
59438	D14							7	8	8	7.7	7	8	8	7.7
	D14							8	8	8	8.0	7.5	8	8	7.8
83443	D12							7	8	6	7.0	6	8	7	7.0
	D13							5	5	4.5	4.8	6.5	7	7.5	7.0
85508	D12							5.5	8	7	6.8	7	8	6	7.0
	D13							5	5	4.5	4.8	6	6	7.5	6.5

I.D.	#	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
										1	2	3	Aver	1	2	3	Aver
84310		D12 D12	5/1	.21	none	2	2.1	33		2 2	2 2	1.5 1.5	1.8 1.8	5 4.5	5 5	4.5 4.5	4.8 4.7
83501		D12 D12								3 2	3.5 1.5	2.5 1.5	3.0 1.7	5 4	5 5	4.5 2.5	4.8 3.8
82406		D12 D12								3.5 .5	3.5 .5	2.5 .5	3.2 .5	5 2.5	5 3.5	4.5 1.5	4.8 2.5
84270		D12 D12								2.5 2	2 2	2.5 2	2.3 2.0	4.5 4.5	4 4	4.5 4.5	4.3 4.3
84317		D12 D12								2 .5	2 .5	2.5 .5	2.2 .5	4.5 2.5	4 2.5	4.5 1.5	4.3 2.2
82393		D12 D12								2 1	2 1.5	2.5 1	2.2 1.2	5 4	4 4	4.5 3.5	4.5 3.8
59615		D14 D14								5 5	5 5	5.6 5.6	5.2 5.2	6.5 6.5	7 7	7 7	6.8 6.8
59446		D14 D14								5 5	5 5	4.5 4.5	4.8 4.8	6 6	7 6	5 4.5	6.0 5.5
59473		D14 D14								5 5	5 5	5 5	5.0 5.0	5.5 5.5	7 7	5 4.5	5.8 5.7
59622		D14 D14								5 5	5 5	4.5 4.5	4.8 4.8	5.5 5	7 6	5 4.5	5.8 5.2
59402		D14 D14								5.5 5	6 6	5 4.5	5.5 5.2	6.5 6	7 7	5.5 5	6.3 6.0
59370		D14 D14								5.5 5	6 5	4.5 4	5.3 4.7	6 6	7 6	5 4.5	6.0 5.5
59631		D14 D14								5.5 6	6 6	5 4.5	5.5 5.5	5.5 6	7 7	5.5 5	6.0 6.0

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3 Aver	1	2	3 Aver		
82344	D12	5/2	.42	none	.84	1.764	33		3	3.5	4	3.5	5.5	4.5	5	5.0
	D12								3	3.5	4	3.5	5.5	4.5	5	5.0
83456	D12								3.5	2.5	4	3.3	6	4.5	5	5.2
	D12								1.5	1.5	4	2.3	4.5	4.5	5	4.7
83441	D12								3	2.5	4	3.2	5.5	4.5	5	5.0
	D12								3	3.5	4	3.5	5.5	4.5	5	5.0
82371	D12								2.5	2.5	5	3.3	5.5	6	5	5.5
	D12								2.5	3.5	5	3.7	5.5	5	5	5.2
82397	D12								3	3.5	4	3.5	5.5	5	5	5.2
	D12								2	2.5	4	2.8	5.5	5	5	5.2
84225	D12								3.5	3.5	5	4.0	5.5	5	5	5.2
	D12								3.5	3.5	5	4.0	5.5	5	6	5.5
59624	D14								6	6.5	6	6.2	8.5	7	5	6.8
	D14								5	5	5	5.0	6	5	5	5.3
59604	D14								6.5	7	6	6.5	8.5	6.5	6	7.0
	D14								5	6	6	5.7	8.5	6	6	6.8
59398	D14								6.5	6	5	5.8	8.5	6	5	6.5
	D14								5	5	5	5.0	6.5	5.5	5	5.7
59426	D14								7	6.5	6	6.5	7	7.5	6	6.8
	D14								6	7.5	6	6.5	7	7.5	5	6.5
59574	D14								6	6	6	6.0	7	7	6	6.7
	D14								6	6	6	6.0	7	7	6	6.7
59606	D14								7	6	6	6.3	7	7.5	6	6.8
	D14								7	6.5	5	6.2	7	7	6	6.7

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1		
								1	2	3 Aver	1	2	3 Aver
82346	D12	5/5 .96	none	.25	1.2	33		.5	.5	.5	3.5	3.5	4.5 3.8
	D12							.5	.5	.5	3.5	3	4.5 3.7
84275	D12							.5	.5	.5	4.5	3.5	4.5 4.2
	D12							.5	.5	.5	3.5	3	3.5 3.3
84289	D12							.5	.5	.5	3.5	3	4.5 3.7
	D12							.5	.5	.5	3.5	3	4.5 3.7
82538	D12							.5	.5	.5	4.5	3.5	4.5 3.0
	D12							.5	.5	.5	2.5	2.5	1.5 2.2
82405	D12							.5	.5	.5	4	4	3.5 3.8
	D12							.5	.5	.5	2.5	2.5	1.5 2.2
84255	D12							.5	.5	.5	3.5	3.5	3.5 3.5
	D12							.5	.5	.5	1.2	1.2	2.5 1.6
59465	D14							2	2	3	2.3	4	4 4.5 4.2
	D14							1	1	1	1.0	2.5	3 2 2.5
59486	D14							3	3	4.5	3.5	4.5	5 5 4.8
	D14							2	2	2	2.0	3.5	3.5 2 3.0
59610	D14							2	3	4.5	3.2	4	4 4.5 4.2
	D14							1.5	2	3	2.2	2.5	3.5 3 3.0
59382	D14							4.5	5	5.6	5.0	4.5	5 5 4.8
	D14							4	4	4	4.0	4	5 4 4.3
59405	D14							4	5	4.5	4.5	4.5	5 4 4.5
	D14							2	3	4.5	3.2	3	5 3 3.7
59550	D14							4.5	5	4.5	4.7	5	5 5 5 5.0
	D14							3.5	4	4	3.8	4	4 5 4.3

I.D.	BADGE #	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1			
									1	2	3	Aver	1	2	3
82382	D12	5/5	.96	none	1	4.8	33	4.5	4	4.5	4.3	5.5	6	6	5.8
	D12								4.5	4	4.5	4.3	5.5	6	6
83462	D12							5	5	4.5	4.8	6.7	6.7	7	6.8
	D12								4.5	4	4.5	4.3	5.5	5	6
84263	D12							4.5	5	4.5	4.7	6.5	6	7	6.5
	D12								4.5	4	4.5	4.3	5.5	5.5	6
82373	D12							4	3.5	4.5	4.0	6.5	7	6.5	6.7
	D12								3	2.5	4.5	3.3	7	6.5	5.5
84238	D12							3	2.3	4.5	3.3	6.5	7	6.5	6.7
	D12								1.2	1	3.4	1.9	5.5	5	5.5
82426	D12							3.5	3	4.5	3.7	6.5	6.5	6.5	6.5
	D12								2.5	2.5	4.5	3.2	6.5	6	5.5
59559	D14							7	9	9	8.3	8.5	9	8.5	8.7
	D14								7	9	8	8.0	8	9	9
59406	D14							6.5	9	8	7.8	9	9	9	9.0
	D14								6.5	9	7	7.5	8.5	9	8.5
59431	D14							7.5	9	6	7.5	9	9	9	9.0
	D14								7	8	7	7.3	8	9	8.5
59642	D14							8.5	7	6.5	7.3	9	9	9	9.0
	D14								7	6.5	6.5	6.7	8	8	8
59455	D14							8	9	7.5	8.2	8.5	9	9	8.8
	D14								8	9	8.5	8.5	9	9	9
59518	D14							9	9	8.5	8.8	9	9	9	9.0
	D14								9	9	8.5	8.8	9	9	9

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0				T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3	Aver	1	2	3
82411	D12	5/5	5.7	none	.25	7.125	33		4.5	4.5	5.5	4.8			8	7.5	7.5	7.7					
									5	5	5.5	5.2			8	7.5	8	7.8					
84247	D12			D12					6	5.6	6.5	6.0			9	8.5	8	8.5					
									5.5	5	5.5	5.3			8	7.5	7.5	7.7					
84268	D12			D12					4.5	5	5.5	5.0			8	7.5	7.5	7.7					
									1.5	2	4.5	2.7			5	5	5.5	5.2					
84295	D12			D12					4.5	5	4.5	4.7			8	8	7.5	7.8					
									4.5	5	4.5	4.7			8	7.5	7.5	7.7					
84279	D12			D12					5	5	5.5	5.2			8	7.5	8	7.8					
									5	5	4.5	4.8			8	7.5	7.5	7.7					
83533	D12			D12					5	5	4.5	4.8			8	7.5	8.5	8.0					
									4.5	5	5.5	5.0			8	7.5	7.5	7.7					
59427	D14			D14					9	9	9	9.0			9	9	9	9.0					
									9	9	9	9.0			9	9	9	9.0					
59428	D14			D14					9	9	9	9.0			9	9	9	9.0					
									7	7	5	6.3			9	9	9	9.0					
59445	D14			D14					9	9	9	9.0			9	9	9	9.0					
									9	9	9	9.0			9	9	9	9.0					
59357	D14			D14					9	9	9	9.0			9	9	9	9.0					
									9	9	9	9.0			9	9	9	9.0					
59396	D14			D14					9	9	9	9.0			9	9	9	9.0					
									9	9	9	9.0			9	9	9	9.0					
59556	D14			D14					9	9	9	9.0			9	9	9	9.0					
									9	9	9	9.0			9	9	9	9.0					

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	Post MMH				Post Interfer.				
									1	2	3	Aver	1	2	3	Aver	
37997	PDAB VAN	8/10	.21	HEAT HEAT	2	2.1	33	40	2.5 40	3 3	3.0 3.5	3.0 3.2	2.8 4	4.0 4	4.0 4	4.0 4.0	
37990	PDAB VAN			SUN SUN					3 3	3 3	3 3	3.0 3.0	3.5 3.5	4 3.5	3.5 3.5	3.7 3.5	
37970	PDAB VAN			HEAT HEAT				40 40	1.2 2.3	2 2.5	2 2.5	1.7 2.4	3 2	3 3	3 3	3.0 2.7	
37963	PDAB VAN			HEAT HEAT				40 40	2 2	2 2	2 2	2.0 2.0	3 3	3 3	2.5 2.5	2.8 2.8	
37985	PDAB VAN			SUN SUN					2.5 3	2.5 3	2.5 3.5	2.5 3.2	3.0 3	2.5 3	2.5 4.5	2.7 3.5	
37958	PDAB VAN			SUN SUN					2.5 2.5	3.5 2.5	3.5 2.5	3.2 2.5	3 3	4 2.5	3.5 3	3.5 2.8	
37968	PDAB VAN			COLD COLD				0 0	3 2	3 2.5	3 2.5	3.0 2.3	3 3	3 3	3.5 3.5	3.2 3.2	
37961	PDAB VAN			UV-254 UV-254					2 2	2.5 2.5	2.5 2.5	2.3 2.3	2.3 2.3	3 2	3 2.5	2.5 2.5	2.8 2.3
37969	PDAB VAN			COLD COLD				0 0	2 3	2 3	2.5 3	2.2 3.0	3.0 3	3.0 3	2.5 3	2.8 3.0	
37962	PDAB VAN			UV-350 UV-350					2 2	2 2	1.5 2.0	1.8 2.0	2.2 2.0	2 2	2 2	2 2	2.0 2.0
37984	PDAB VAN			COLD COLD				0 0	2 2	2 2	2 2	2.0 2.0	2.5 2	2.5 2	2.5 2	2.5 2.0	
37977	PDAB VAN			UV-254 UV-254					2.5 3	3 3	3 3	2.8 3.0	3.5 3	3 3	3.5 3	3.3 3.0	

Badges were exposed to MMH first, interferent second

PDAB color dots read on vanillin scale

Badges exposed to heat and cold for 4 hours, to UV for 0.5 hours

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE (ppm)	MMH INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	Post Interfer.				Post MMH				
								1	2	3	Aver	1	2	3	Aver	
38173	P	8/17	.21	HEAT	2	2.1	33	40	.5	.5	.5	.5	2.5	2.5	2.0	2.3
	V				HEAT			40	.5	.5	.5	.5	2.5	3	3	2.8
38180	P			HEAT				40	.5	.5	.5	.5	2	2	2.5	2.2
	V				HEAT			40	.5	.5	.5	.5	2.5	2.5	2	2.3
37904	P			HEAT				40	.5	.5	.5	.5	2.5	2.5	2	2.3
	V				HEAT			40	.5	.5	.5	.5	2	2	2	2.0
37878	P			COLD				0	.5	.5	.5	.5	2	2	2	2.0
	V				COLD			0	.5	.5	.5	.5	2	2	2	2.0
37887	P			COLD				0	.5	.5	.5	.5	3.0	3.0	3.0	3.0
	V				COLD			0	.5	.5	.5	.5	4	4	3.5	3.8
37896	P			COLD				0	.5	.5	.5	.5	2	2	2.5	2.2
	V				COLD			0	.5	.5	.5	.5	3	3	3	3.0
3793	P			UV-254				.5	.5	.5	.5	.5	3	3.5	3.5	3.3
	V				UV-254			.5	.5	.5	.5	.5	3	3	3.4	3.1
37960	P			UV-350				.5	.5	.5	.5	.5	3	3.5	3.5	3.3
	V				UV-350			.5	.5	.5	.5	.5	3	4	3	3.3
37980	P			UV-350				.5	.5	.5	.5	.5	3	3	3	3.0
	V				UV-350			.5	.5	.5	.5	.5	3	3	3.5	3.2

Badges were exposed to interferent first, MMH second

Badges were exposed to heat and cold for 2 hours, to UV for 0.5 hours

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3	Aver	1	2	3	
38184	P V	8/18	.96	none	3	14.4	33		5 5	5 5	5 5	5.0 5.0	5.5 5.5	5.5 5.5	5.5 5.5	
38177	P V								5.5 5.5							
38170	P V								5.5 5.5							
38172	P V								5.5 5.5							
38206	P V								4.5 5	4.5 5	4.5 5	4.5 5.0	5.5 5.5	5.5 5.5	5.5 5.5	
38236	P V								5.5 5.5	4.5 4.5	5 5	5.0 5.0	5.5 5.5	5.5 5.5	5.5 5.5	
38169	P V	8/21	.14	none	.25	.175	33		.5 .5	.5 .5	.5 .5	.5 .5	.5 1	.5 1	.5 1	.5 1.0
37909	P V								.5 .5	.5 .5	.5 .5	.5 .5	.5 .	.5 .	.5 .	.5 .
38147	P V								.5 .5	.5 .5	.5 .5	.5 .5	.5 .	.5 .	.5 .	.5 .
38161	P V		.14	none	.5	.35			.5 1	.5 1	.5 1.5	.5 1.2	1.5 1.5	.5 1	.5 1.5	.8 1.3
38226	P V								.5 1	.5 1	.5 1	.5 1.2	1.5 1.5	1 1	1 1.5	1.2 1.3
38154	P V								.5 1	.5 1	.5 1.5	.5 1.0	1 1	.5 1	.5 1.5	1.2 1.3
38163	P V		.14	none	1	.7			1 2.5	1.5 3	1 2.5	1.2 2.7	2.5 3	2.5 3	2.5 3	2.5 3.0
38156	P V								2 3	1.5 3	1.5 3	1.7 3.0	3 3	3 3	3 3	3.0 3.0
37848	P V								2 3	1.5 3	2 3	1.8 3.0	2.5 2	2.5 3	3 3	2.7 2.7

I.D. #	BADGE TYPE	DATE	MMH (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
38144	P	8/21	.21	none	.25	.2625	33		.5	.5	.5	.5	.5	.5	.5	.5
	V								.5	.5	.5	.5	1	1	1	1.0
38143	P								.5	.5	.5	.5	1.5	1.5	1.5	1.5
	V								1	1	1	1.0	1.5	1	1.5	1.3
38142	P								.5	.5	.5	.5	1.5	1.5	1.5	1.5
	V								1	1	1	1.0	1.5	1	1.5	1.3
37828	P		.21	none	.5	.525			1	1	.5	.8	2	2	2	2.0
	V								2	2	2	2.0	2	2	2	2.0
38212	P								1	.5	.5	.7	2	2	1.5	1.8
	V								2	2	2	2.0	2	2	2	2.0
38162	P								.5	.5	.5	.5	1.5	2	1.5	1.7
	V								2	2	2	2.0	2	2	2	2.0
37967	P		.21	none	1	1.05			2	1.5	1.5	1.7	2.5	2.5	2.5	2.5
	V								2.5	2.5	2.5	2.5	3	3	2.5	2.8
38155	P								1.5	1.5	1.5	1.5	2.5	2.5	2.5	2.5
	V								3	3	3	3.0	3	3	3	3.0
38148	P								2	2	1.5	1.8	2.5	3	2.5	2.7
	V								3	3	3	3.0	3.5	3.5	3.5	3.5

I.D.	BADGE	DATE	MMH	INTER-	TIME	DOSE	RH	TEMP	T=0			T=1										
									#	TYPE	(ppm)	FERANT	(hrs)	TLV-hrs	(%)	(C)	1	2	3 Aver	1	2	3 Aver
37974	P	8/21	.42	none	1	2.1	33		3	2.5	2.5	2.7	3.5	4.0	3.5	3.7						
									4	4	4	4.0	4.5	4	4	4.2						
37981	P								2.5	2.5	2.5	2.5	3.5	3.5	3.5	3.5						
									4	4	3.5	3.8	4	4	4	4.0						
37964	P								2.5	2.5	2.5	2.5	3.5	3.5	3.5	3.5						
									4	4	4	4.0	4.5	5	4	4.5						
37816	P		.42	none	.25	.525			1	1	1	1.0	2.5	2.5	2.5	2.5						
									3	3	3	3.0	3	3	3	3.0						
37971	P								1.5	1	1	1.2	2.5	2.5	2.5	2.5						
									2.5	2.5	2.5	2.5	3	3	3	3.0						
37778	P								.5	.5	.5	.5	1.5	2	1.5	1.7						
									2.5	2.5	2.5	2.5	3	2.5	2.5	2.7						
37831	P		.42	none	.5	1.05			1	1.5	.5	1.0	2.5	2.5	2.5	2.5						
									1.5	1.5	1.5	1.5	3	3	3	3.0						
37848	P								1.5	2.5	1.5	1.8	3	3	2.5	2.8						
									3.5	3.5	3.5	3.5	4	4	4	4.0						
37815	P								3	2.5	3	2.8	3.5	3.5	3.5	3.5						
									3	3	3.5	3.2	4	4	4	4.0						

GMD COLOR BADGE LOG SHEET

I.D.	BADGE	DATE	MMH	INTER-	FERANT	CONDITIONS	RH	TEMP	HOURS OF EXPOSURE							
									#	TYPE	(ppm)	.25	.5	.75	1	2
37839	P	8/29				SUN DIRECT	HORIZ		.5	1	1.5	1.5	1.5	1.5		
									0	0	0	0	0	0		
37830	P						VERT		.5	1.5	1.5	1.5	1.5	2		
									0	0	0	0	0	0		
37849	P					DIFFUSE	HORIZ		.5	.5	.5	.5	.5	1		
									0	0	0	0	0	0		
37879	P						VERT		.5	.5	.5	.5	.5	1		
									0	0	0	0	0	0		

PDAB color dots were read on vanillin scale

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	Hz (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0			T=1				
									1	2	3	Aver	1	2	3	
38229	P V	9/13	.0896	none	.25	.224	40		.5 .5	.5 .5	1 1	.7 .7	1	1.5 1	1.5 1	1.3 1.0
38222	P V								1.5 1.5	1.5 1.5	2 1	1.7 1.3	2.5 1.5	2.5 1.5	2.5 1	2.5 1.3
38228	P V								1.5 1	1.5 1	1.5 1	1.5 1.0	2.5 1	2.5 1	2 1	2.3 1.0
38201	P V		.0896	none	.5	.448			2.5 2	2 1.5	2.5 1.5	2.3 1.7	2.5 2	2.5 1.5	3 2	2.7 1.8
38193	P V								2.5 2	2.5 2	2.5 2	2.5 2.0	2.5 2.5	2.5 2.5	3 2	2.7 2.3
38234	P V								2.5 2	2.5 2	2.5 2	2.5 2.0	2.5 2	2.5 2.5	3 2.5	2.7 2.3
38125	P V		.0896	none	1	.896			3.5 2	3.5 2	2.5 1	3.2 1.7	4 2.5	4.5 2.5	4.5 2.5	4.3 2.5
38199	P V								2.5 2	2 2	2.5 2	2.3 2.0	3 2	3 2	3 2	3.0 2.0
38125	P V								2 1.5	2.5 1.5	1.5 1.5	2.0 1.5	2 1.5	2 1.5	2 1.5	2.0 1.5
38062	P V		.0896	none	2	1.792			3.5 2.5	3 2.5	3.5 3	3.3 2.7	3.5 3	3.5 2.5	3.5 2.5	3.5 2.7
38063	P V								3 2.5	3 2.5	3.5 3	3.2 2.7	3 3	3.5 2.5	3 3	3.2 2.8
38046	P V								3.5 3	3.5 3	4 3	3.7 3.0	4 3.5	3.5 3	4 3.5	3.8 3.3
38061	P V		.163	none	.25	.4075	40		1 2	1 1	1 2	1.0 1.7	2 2	2 2	2 2	2.0 2.0
38069	P V								1 1	1.5 2	1 1	1.2 1.3	2 1	2 1	2 1	2.0 1.0
38070	P V								1 1	1 1	1 1.5	1.0 1.2	2 1.5	2 1.5	2 1.5	2.0 1.5
38059	P V		.163	none	.5	.815			1.5 1.5	1.5 1.5	1 1	1.3 1.3	2.5 2.5	2.5 2.5	2 1.5	2.3 2.2
38060	P V								1.5 1.5	1.5 1.5	1 1	1.3 1.3	2.5 2.5	2.5 2.5	2 3	2.3 2.7
38045	P V								1.5 1.5	1.5 1.5	1.5 1.5	1.5 1.5	2.5 2.5	2.5 2.5	2.5 2	2.5 2.3

GMD COLOR BADGE LOG SHEET

I.D. #	BADGE TYPE	DATE	Hz (ppm)	INTER- FERANT	TIME (hrs)	DOSE TLV-hrs	RH (%)	TEMP (C)	T=0				T=1			
									1	2	3	Aver	1	2	3	Aver
38080	P V	9/15	.163	none	1	1.63	40		2.5 2.5	2.5 2.5	2.5 2	2.5 2.3	3 3.5	2.5 0	3 3	2.8 3.0
38081	P V								2.5 0	2.5 0	2.5 0	2.5 .0	3.5 0	3 0	3 0	3.2 .0
38082	P V								3.5 2.5	2.5 2.5	2.5 2	2.8 2.3	3.5 3	3.5 3	3.5 3	3.5 3.0
38064	P V		.163	none	2	3.26	40		3.5 3	3.5 3	3.5 3.5	3.5 3.2	3.5 4	3.5 4	3.5 4	3.5 4.0
38077	P V								3.5 2.5	3 2.5	3.5 3	3.3 2.7	3.4 3	3 3	3 3	3.1 3.0
38093	P V								3.5 3.5	3.5 3	3.5 3.3	3.5 3.3	3.5 4	3.5 4	3.5 4	3.5 4.0
38072	P V		.163	none	2	3.26	80		3 3	3 3	3 3	3.0 3.0	4.5 3.5	4 4	4 4	4.2 3.7
38078	P V								2.5 3.5	3 3.5	3 3.5	2.8 3.5	3.5 4	4 4	3.5 4	3.7 4.0
38079	P V								2.5 3.5	3 3.5	3 3.5	2.8 3.5	3.5 4	3.5 3.5	3.5 4	3.5 3.8
38076	P V	9/19	.163	none	2	3.26	25		4.5 4	4 4.5	4 4	4.2 4.2	4.5 5	4.5 5	4.5 5	4.5 5.0
38083	P V								4.5 4	4.5 4	4.5 4	4.5 4.0	5 5	4.5 5	4.5 5	4.7 5.0
38065	P V								4.5 4	4 4.5	4.5 4.5	4.3 4.3	5 4.5	5 5	5 5	5.0 4.8
38075	P V		.0896	none	2	1.792	25		1.5 1	1.5 1	1.5 1	1.5 1.0	2.5 1.5	2.5 1.5	2.5 1	2.5 1.3
38073	P V								2.5 2	2.5 2	2.5 1.5	2.5 1.8	4 2.5	4.5 2	4.5 2	4.3 2.2
38074	P V								2.5 2	2.5 2	2.5 2	2.5 2.0	3.5 2.5	3.5 2.5	3.5 2	3.5 2.3